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Devoted to Civil Engineering and Contracting

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February 19, 1925

Bull Riveter, 21-ft. diam. Penstocks, Niagara Falls, N. Y.

This Issue: 3—70,000 hp. Turbines Installed at Niagara Falls—Building Lake Humphreys Concrete Arch Dam—Substructure Plan and Design: Buffalo Filter Plant—Hydraulic Surveys Applied to Design of Highway Bridges—Reviews of Recent Books on Engineering Subjects

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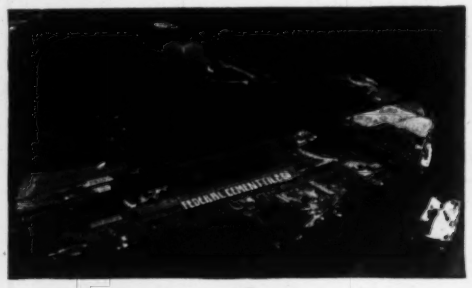

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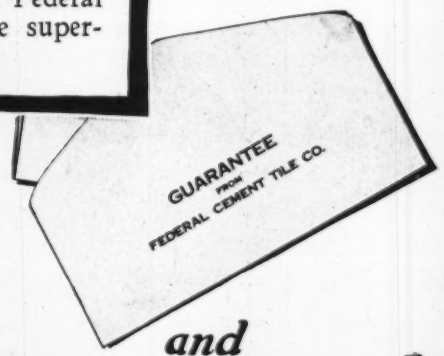

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 94 NEW YORK, FEBRUARY 19, 1925 Number 8

The Education of Dr. Work

A YEAR and a half ago the Secretary of the Interior had a low opinion of engineers. Possibly he had some sort of understanding of what are the essentials of engineering, but he showed every evidence of considering them largely routine and certainly narrow and specialized. An engineer was good enough to "build dams and dig ditches" but executive direction required a business man—or possibly a physician. But the Secretary is learning. First he reluctantly had to admit the incapacity of his "business man" to head the reclamation work of the government and had further to admit that in an engineer could he find the combination of technical knowledge and broad view that is necessary to direct this important development activity. And now he goes further and voluntarily endorses for the governorship of Alaska an engineer, who joins to a life long experience in that unique territory the technical training and practice which not long ago the Secretary considered so cramping to constructive leadership. The truth is mighty and will prevail.

For an Engineering Museum

ENGINEERS, in the language of the army and the vaudeville stage, are hard-boiled. Their whole training, and the demands of their clients and their employers, lead them toward practicality. Co-ordinate with "will it work?" they must answer "will it pay?" But more and more they are coming to learn that the answer to the latter question is not always written in immediate dollars and cents and that there are other dividends than those listed by the accountants. The proposed National Museum of Engineering and Industry is a testimonial to this new view. Museums are not "organized for pecuniary profit," as the tax-law phrase goes, but they are profitable nevertheless. But hitherto the profit has shown in art and archæology, with a trace of the sciences. Practical science has had too little place in museum planning. Thanks to the generosity of Henry Towne, himself a great engineer and industrialist, the nucleus of an engineering museum has been formed. Engineers everywhere should get behind the movement to make some sort of finished plan an actuality.

Power at Niagara Falls

TWENTY-FIVE years ago there occurred at Niagara Falls an event which caused wide comment throughout the scientific world—the first 5,000-hp. hydro-electric generators were put into service. At that time they were, by far, the largest ever built. Since then similar events at Niagara have marked the advance of hydro-electric development; each time the new generators being the largest of their kind. Early this year the celebration of the 25th anniversary of the installation of the 5,000-hp. generators also marked the completion of the latest, and again the largest, hydro-electric generators, three of 70,000 hp. capacity each. In all probability these great waterwheels will remain the largest ever built as they are considered to have about reached the point where the structural difficulties of design outweigh the advantages to be gained by increased size. It is even doubtful whether the engineers of the power company would have resorted to such great sizes had not the restrictions of the site made them necessary, for the great quantity of power from these units is not an easy thing to handle even as part of a large power system. The description of the work of installing the new units and of altering the existing hydraulic structures on the American side at Niagara Falls to bring water to them is completed in this issue. The outstanding feature of this story is that it was only by careful planning, organization, and co-operation between engineers, contractors, and manufacturers that this piece of construction restricted on all sides by the physical features of the site and using penstocks, valves, turbines, and generators of unprecedented size, was brought to successful completion without serious delay or accident.

Protesting Against a Nuisance

THE American habit of protesting against sites chosen for garbage and refuse disposal plants has been copied in France. The French protest has taken on a unique form. First, the entire municipal council of Meudon resigned because a salvaging and incinerator plant for the disposal of Paris refuse was to be located in Meudon. On an election called for Jan. 25 by the Prefect of the Seine and Oise, to elect a new council, an associated press dispatch states, not one of the 3,899 registered voters went to the polls. For decades past American objectors to sites chosen for garbage and sewage disposal works have been assured that in England and on the continent these municipal necessities are commonly located in closely built-up districts. The argument will lose force if happenings like that at Meudon are repeated.

Improved Road Forms

PRECISION in form construction and maintenance has forced itself into attention as a controlling operation in concrete road building. The reason is plain. If the forms are not set accurately to grade and are not rigidly held there, the road surface exhibits the impression of every irregularity. And forms must be strong and be rigidly supported to carry without deflection the modern heavy finishing machine with its vibratory tamping action. Most highway engineers now require steel forms and, in general, manufacturers are making the form girder, or rail, amply strong and are develop-

ing more perfect joints and rail supports. The greatest fault in practice is poor form setting and maintenance. The men in the field have been slow to realize the additional duty which the finishing machine has put onto road forms. Their original duty as a side mold and a guide to surface alignment has been enlarged; they now must serve as a track for the heavy traveling loads of subgrader and finishing machine. All this is elementary but it is exceedingly important to keep in mind in view of the closer limits which concrete road specifications are setting for surface irregularities. If present indications continue, contractors may expect to find this year and next an extension of present specifications controlling forms and form setting. Inspection will also become more rigid. These changes will affect costs. In preparing for their spring bidding, contractors will do well to regard carefully changes in specifications for forms and in form inspection practice.

New Gas Tax Laws

PREDICTION a year ago of increased gasoline taxes has been confirmed by the appearance of a flock of bills which either increase present tax rates or enact taxes in those states where motor-vehicle fuels have been untaxed. As the newspapers explain the new act, they exhibit about all the vagaries and faults of the thirty-five odd state laws now in force. They vary in methods of assessing, collecting and allotting the tax. It is, however, particularly in distributing the income that most of these laws are indefensible. There is no justification for placing a special tax on road users for using the roads and giving the money to the general state fund. The gasoline tax is a road tax and deserves no support or recognition unless the proceeds are turned into road improvement. The new acts proposed are rather remarkable for the number which bury the money in the general state tax fund available for all state administration purposes. Unmodified, these acts should never be allowed to become laws.

Indicting the Oyster Industry

MYSTERY still shrouds the cause of the recent heavy excess of typhoid in New York City and Chicago. The only things certain are that the two cities named had well towards a thousand cases above their "expectancy;" that the histories of the cases pointed to shell oysters; that the steps taken by the local health authorities of New York, Chicago and the State of Illinois were, in effect, an indictment of the entire oyster industry of the Atlantic seaboard; that the indictment dealt the industry a staggering blow from which it will not recover for years; that it was evident to competent disinterested observers that the entire oyster output thus indicted could not be infected; that although the excess typhoid in the cities most afflicted fell gradually to or near the expectancy in the weeks following the indictment this might have happened without the embargo; that the entire course of events is more correctly an indictment of the municipal and state authorities concerned than of the oyster industry as a whole; that better sanitary control of the oyster and better correlation of city, state and federal agencies to that end is needed; that neither the city and state health departments on the one hand nor the oyster industry on the other seems to have made full use of the sanitary engineer, chemist and biologist to prevent such an outbreak or after its occurrence to establish speedily and with certainty its exact cause; and finally that if further study shows its need purification methods so effective in safeguarding the water and milk supplies can, with proper modifications, be applied to oysters.

We are well aware that when the public health is at stake all other interests must be sacrificed. We are also aware of the heavy responsibility that rests upon local and state officials at such times. But when these authorities have to work as blindly as in the present instance it is nothing short of a confession of lack of exercise of sanitary control in the first instance and of being baffled and bewildered in finding the specific cause of a typhoid outbreak if resort is had to putting an embargo on all oysters. A sheriff does not arrest the population of an entire county lest an unknown murderer commit more murders. Or to bring the comparison back into the public health field, the health officer does not shut off the milk supply of an entire city because milk infection is the only explanation he can find for a typhoid outbreak and he cannot put his finger on the infected milk and fears that there may be an exchange of milk or milk bottles between distributors with safe and unsafe milk.

Preliminary reports by the federal health service and by a New York joint legislative committee, the first given in full and the second in brief abstract elsewhere in this issue, lead us to conclude that the evidence against the oyster is as yet still largely circumstantial, that if the outbreaks were due to oysters the pollution was markedly localized, by chance and temporary. In effect, the federal report may be said to dismiss the indictment of the entire oyster industry by the health officials of New York City, Chicago and the State of Illinois.

As to how this temporary infection, if such it was, of the oysters of a single producer, forming only a small part of the entire oyster supply, came about the report does not go beyond a sort of John Doe indictment, in mentioning "oysters infected in one or more beds or parts of beds or at one or more floats." Presumably the final report will be more specific. If not, the Public Health Service conclusions will be open to the same general charge of mystery and inability to bridge the gap between the oyster and its alleged victims as have been all the allegations of the local and state health authorities.

Significant of the changes in municipal sanitation since the days of high typhoid only some ten to fifteen years past is the fact that nowhere has there been a suspicion expressed that the excess typhoid was due to contaminated water supply. There was some loose talk of city sewage being the cause, with specific mention of the opening of the Passaic Valley trunk sewer early last August, but not an echo of this appears in either the New York State legislative committees or the federal health service report. Nothwithstanding this freedom of both water supply and city sewage from responsibility the typhoid outbreak and the way it has been handled is of vital interest to municipal and sanitary engineers.

The sanitary engineer has been a great factor in putting our public water supplies on so high a plane

that typhoid from them has almost disappeared and would vanish entirely if the engineer were given money and power for the full application of his methods. Pasteurization combined with inspection of milk is rapidly making the milk supply safe. The sanitary engineer and biologist stand ready to safeguard the oyster in the same general way. They and the shellfish producers have already freed the bulk of the oysters and clams of the country from danger of city sewage infection by sewage diversion and perhaps to a small degree by sewage treatment, but most of all by choosing safe growing and floating grounds (waters) for the oyster. Something more seems to be needed, in New York waters, at least, in the way of protecting the growing and the freshening oyster from pollution by the men engaged in the industry itself, and much more in some states to see that oysters are not handled by typhoid carriers or incipient typhoid victims. If this be not sufficient, attention should be turned to oyster purification as it has been so successfully turned to water purification and milk pasteurization. The oyster clorination plant at Inwood, developed with the co-operation of the New York State Conservation Commission, the U. S. Bureau of Chemistry, the U. S. Public Health Service (see *Engineering News-Record*, June 14, 1923, p. 1047) points the way to oyster purification, if it should yet be proved that it is the only or the most feasible way to make the oyster a sanitarily dependable food. We do not think the case against the oyster so bad as to require the universal application of this method but it is comforting to know that the engineer stands ready to design and operate such plants when and where needed.

A New Reclamation Policy

A FAR-REACHING change in national development policy is proposed by the Kendrick Bill, now before the Senate. The bill would authorize the Department of the Interior, in constructing any new reclamation project, to segregate a tract of public land within the project and operate it as an aided-colonization unit. The details of the proposed experiment make the system substantially identical with that of the California state land settlements and with aided-colonization enterprises in various countries abroad. Nothing remotely similar has been done by the federal government of the United States throughout its past history. Direct stimulation of development has been looked upon as paternalistic, and to be shunned except in connection with war-time industrial promotion. The proposed legislation thus represents a radical innovation, one which invites careful reflection on the part of all who appreciate the importance of our national development policies.

To outline the procedure which the bill would set up: Before a new reclamation project is opened, a tract of land large enough to provide 100 farms and 10 laborers' allotments may be segregated by the Secretary of the Interior, at his discretion. Free-for-all settlement will not be permitted on this tract, but settlers are to be selected according to farming qualifications and capital. They must have at least one year's practical experience on a farm, and must possess $1,500 in money or farm equipment ($200 in case of the laborer). To aid the settlers in developing their allotments into productive farms, they may be financed by the government through loans on permanent improvements (the government furnishing up to 60 per cent of the cost if the settler furnishes the rest) and on live-stock purchases. In addition, such advice and supervision is to be made available to them as will give them the best possible opportunity for making a success. This advice and supervision incidentally will speed the repayment of the loans. The settlers are required to pay for their land on a 40-year amortization basis, with interest at 4 per cent, and for the improvement loans on a similar time basis, of shorter periods. The settler's land cannot be transferred until cleared of debt, except under special restrictions.

In past reclamation, farm units have been distributed on the first-come first-served plan, offering the same opportunity to the land shark or to the city failure as to the experienced farm worker. All the settlers were allowed and required to go it alone, whether or not they knew how to tackle the job of developing a desert farm. No agricultural advice and no financial assistance were offered by the government; the law prevented, and advice or supervision were decidedly not wanted by the settlers, though government loans no doubt would have been welcome at any time. To make up for the chances of hard luck in pioneering, the law not only provided that the land might be paid for on the installment plan but also threw off the interest, so that final accounting would show the settlers' payments to the government to total only a small part of the real cost of the project. This subsidized hit-or-miss system has produced the wildest imaginable variety of results, in which the elements of misfortune and tragedy were represented on a large scale.

The system proposed by the Kendrick Bill would, in the first place, eliminate the subsidy by duly charging interest, and thus it would put reclamation on a sound and honorable basis. It would prevent the notoriously unfit from being intrusted with the management of a property in which the government has invested a large sum of money and on whose success all the remainder of the community depends. It would avoid the serious harm that can come from lack of development capital, misfortune, mistakes in cropping or marketing and exploitation by usurers and middlemen.

How radical a change over existing methods is proposed in the new bill will be sufficiently clear from the preceding outline. Future land settlement would become very different indeed from that which characterized the log-cabin period. But for that matter it is today. Conditions have changed so profoundly that the practices of a half century ago are no longer adequate.

It is to be observed that even now it is not proposed to apply the loan-and-aid plan generally, but only to an experimental area on each new reclamation project. Those settlers who prefer the old plan of going it alone will have ample opportunity to satisfy their wishes by locating on another portion of the project. The plan of starting the experiment therefore seems to call for active support. If the experiment should fail, no particular harm would result—though such failure would probably not be distinguishable from the condition on those of the present projects which refuse to pay their bills. If the experiment should succeed, on the other hand, it would mean a virtual revolution in Western development.

Three 70,000-Hp. Turbines Installed at Niagara Falls

New Units Make 90,000 More Horsepower Available Without Additional Draft on the River—Hydraulic Canal Repaired and Enlarged — Intake Deepened and New Ice Fenders Built

THREE hydro-electric generators of 70,000-hp. capacity each have been put into service recently by The Niagara Falls Power Co. on the American side at Niagara Falls as part of its program for obtaining the maximum amount of power possible out of the 19,500 sec.-ft. of water available for use on the American side under the present treaty. Besides the installation of these new units, the program included the driving of a 32-ft. tunnel from a point adjacent to the inlet of the hydraulic canal at Port Day above the Falls to a new basin near the edge of the cliff below the Falls, a distance of 4,300 ft.; the enlarging of the hydraulic canal to get a water cross-section area of at least 1,950 sq.ft.; the deepening and straightening of the intake channel in the river in front of Port Day; and the repair and extension of the ice fenders in the river at that point.

The three new turbines use the water formerly used by the 21 turbines in the old Niagara Plant above the Falls. The new plant has a nominal capacity of 210,000 hp. in place of the 105,000 hp. developed in the old plant. The Niagara Plant, in which the old wheels developed 11.6 hp. per second-foot, will be held in reserve. The new wheels develop about 22 hp. for the same flow. The increase is obtained by the greater efficiency of the new turbines and the additional head made available by the improved installation.

The construction program for the installation of the three new units, known as Station 3 C, was laid out so that the tunnel would be completed some months in advance of the completion of the power house. This early completion of the tunnel permitted its being used to supply the existing units in Stations 3 A and 3 B, thus making it possible to unwater and deepen the hydraulic canal before both the canal and the tunnel were needed for all three stations down in the Gorge, Stations 3 A, 3 B and 3 C. The driving of the tunnel, started April 25, 1921, was entirely completed March 26, 1923, and water was turned in April 23, 1923. The tunnel work was described in *Engineering News-Record*, April 27, 1922, p. 678.

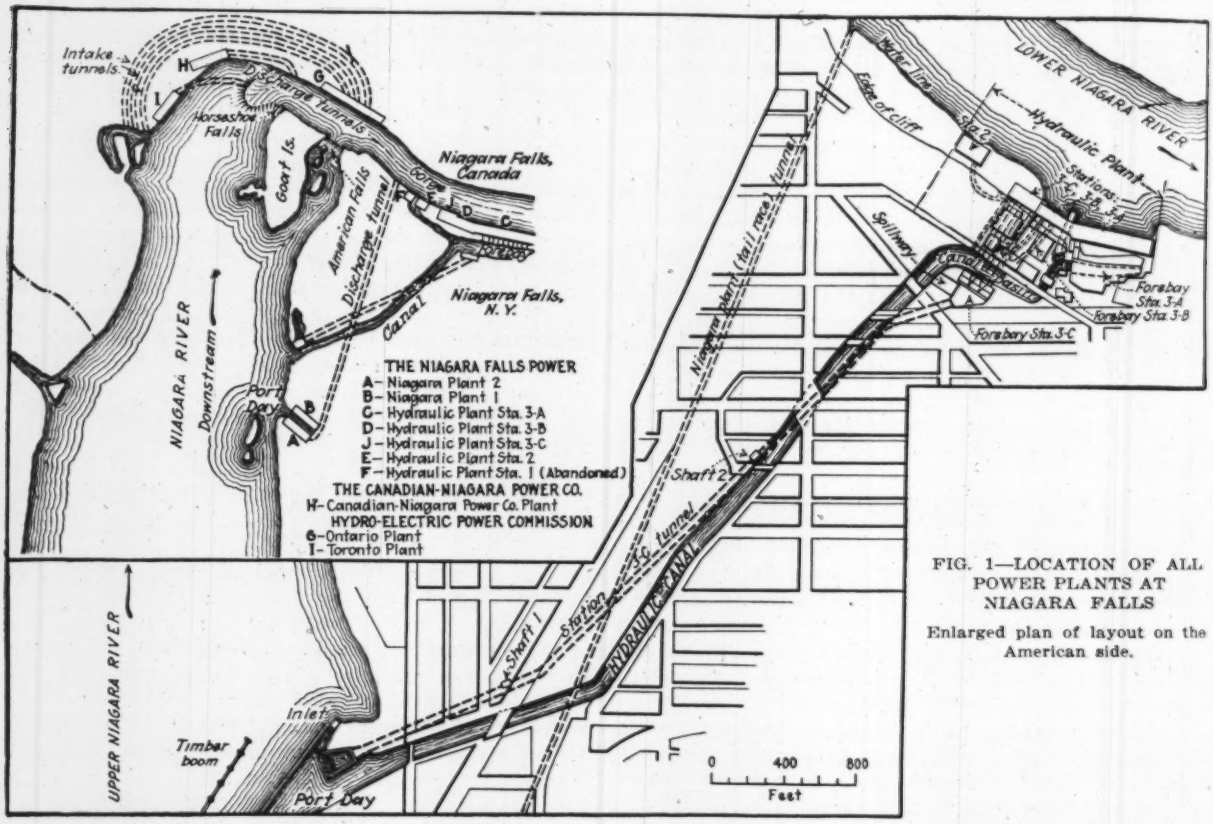


FIG. 1—LOCATION OF ALL POWER PLANTS AT NIAGARA FALLS

Enlarged plan of layout on the American side.

Penstocks—The three 21-ft. diameter, concrete-lined penstocks, extending from the tunnel forebay near the top of the cliff to the power house in the Gorge, are excavated through rock for their entire length as shown in Fig. 2. The lower 96 ft. of each penstock is lined with steel plates 1⅛ in. thick and 1⅜ in. thick at the valve section, to provide an impervious reinforcement and connection with the Johnson valves at the power house.

Each penstock shaft was driven from the lower end, the horizontal section being driven by a top heading and a closely following bench, and the sloping section by a shallow bottom heading enlarged to full size after

it had been cut through to the top of the cliff. This method was used on account of the low cover at the top of the cliff where the penstocks come up under the canal basin to reach the forebay at the tunnel mouth. The minimum thickness of cover at this point is only 16 ft. and the condition of the rock was uncertain. When the shaft had been opened through, it was enlarged to full section starting at the top and working down, the muck going down through the heading to a hopper built in the lower end above floor level in the horizontal section, where it was loaded on cars and taken to the dump. Muck was allowed to accumulate in the heading for its full length so that the top was always sufficiently full to provide a working place for the drillers enlarging the heading. This method resulted in a great saving of staging.

The concrete lining was placed with collapsible steel forms mounted on a traveler. Twelve 5-ft. sections of collapsible lining forms were used. The bend in the penstock was lined by using special wedge-shaped sections between alternate regular sections. Concrete was supplied by a small mixer located near the upper end of the shaft.

The steel lining of the lower end was not put in place until after the frame of the power house was up and it was possible to deliver the heavy sections with the traveling crane of the power house. Each complete circular section was assembled at the outer end of the tunnel on a saddle set on a carriage which ran on a track laid in the bottom of the tunnel at such elevations that the bottom of each section when run back into place would be at correct line and grade. The sections were riveted by a bull riveter shown in Fig. 4. The completed sections were pulled back into the tunnel as each section was completed. When the whole had been assembled it was concreted into place, the saddles and carriages being left in.

The bull riveter was supported by the power-house crane. It could reach all but a short portion of the bottom joints, which had to be riveted by hand. In order that this work of riveting should not interfere with the construction of the turbines, it was necessary to do it at about the line of the back wall of the power house. As there was not sufficient clearance for the riveter to work between the column foundations in the power-house wall, temporary piers were built on the line of the columns, but far enough off center of the columns to provide clearance and the columns were carried on beams cantilevered out over the opening as shown in Fig. 4 and Fig. 13. When it was necessary to run the power-house crane with heavier pieces of machinery out beyond this point short steel columns were wedged in under the ends of the cantilevers to give extra support.

Later, when the Johnson valves were being installed at the outer end of the steel penstocks, a 50-ton crane was brought in and erected on a short temporary craneway over the center line of each valve. The Johnson valves have an inlet diameter of 21 ft., outlet diameter 14 ft. and are 24 ft. 4½ in. in diameter at the largest point. They are built up of cast and plate steel. Each valve weighs approximately 307 tons. On account of their great size it was necessary to assemble them in saddles in order to keep them from deforming under their own weight before they were completely assembled.

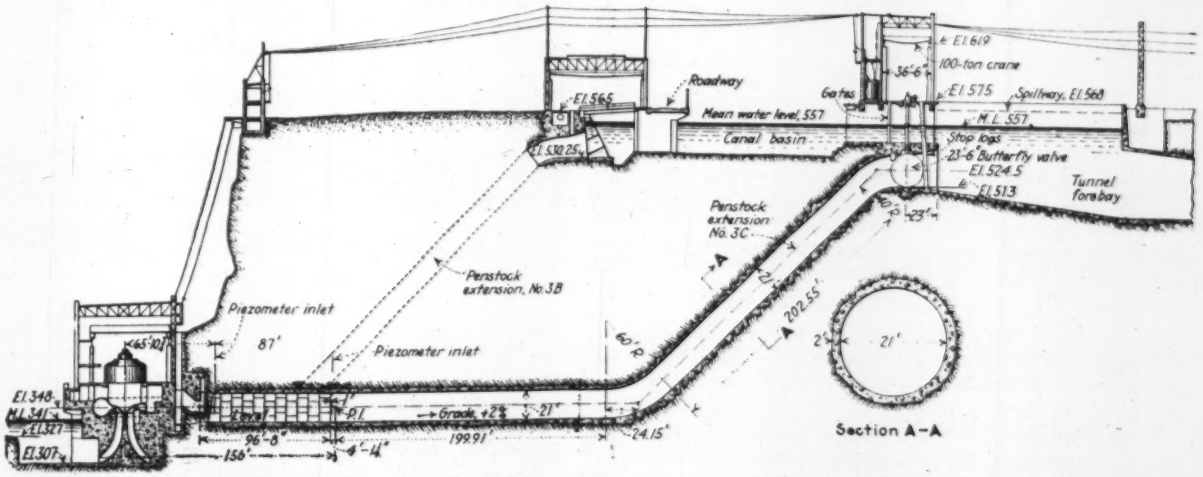


FIG. 2—CROSS-SECTION THROUGH CLIFF SHOWING RELATION OF PENSTOCKS, INTAKES AND POWER HOUSE

Gatehouse—Meanwhile the forebay at the lower end of the tunnel had been excavated. Its position is shown in Fig. 5. As it was eventually to be connected with the canal basin through the new gatehouse a cellular steel sheetpile cofferdam was built on the rock bottom along the side of the canal basin to close off the portion of the intervening walls of earth and rock. This cofferdam and similar ones built to close off the canal and to excavate the tailrace were filled with coarse sand and gravel. This material was used in preference to earth or clay because it settles immediately and puts sufficient strain on the sheetpiling to close the joints and make them watertight. The gatehouse is shown in Figs. 5 and 6. The inlets to the three penstocks are at the lower level. They are bell mouths, closed by butterfly valves 23 ft. 6 in. in diameter, built up of cast and plate steel.

The temporary gates built to close the gate openings in the gatehouse during construction and shown in Fig. 6 are unusual and of interest. They were made of 24-in. I-beams, placed horizontally and spaced according to the water pressure, and filled for part of their depth with concrete. Other I-beams placed vertically at each side made the sliding faces and held the whole gate together. Intermediate stiffness was provided by

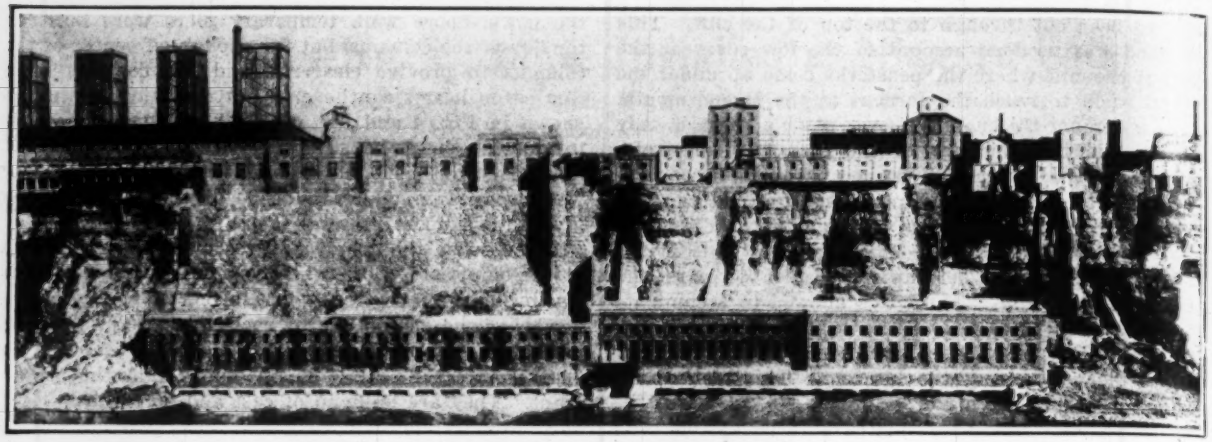


FIG. 3—THREE POWER STATIONS IN NIAGARA GORGE
New station, 3C, at the right. Cantilever crane-way for lowering machinery to the power house is just to the right of the square tower at the center of the picture.

filling a narrow section of the space between the I-beam at the center of the gates to its full depth with concrete. These gates were made quickly, served well for the purpose, and when the work was finished were easily cut apart and the I-beams salvaged.

Gate recesses are provided near the outer end of each bell mouth into which sectional gates of structural steel can be lowered from the gatehouse floor when it is necessary to close off the opening to repair the butterfly gates.

The butterfly gate valves are operated hydraulically from the gatehouse floor and are designed to close under the extreme condition of a free flow through the penstocks. No butterfly valves approaching these in size have ever before been built.

On the level above the penstock gates are five drop-leaf gates in the wall separating the canal basin from the tunnel forebay. These gates are for balancing the flow between the canal and the tunnel.

The gates for these openings are of structural steel; two operated by electrically driven gear trains and the other three by the gatehouse traveling crane. Since they are not for emergency use, this arrangement gives sufficient range for controlling the flow through the gatehouse.

At each end of the gatehouse structure are stilling chambers from which water for the transformers and the lignum-vitae bearings of the generators is drawn and to which heated water from the transformers can be returned in cold weather to prevent formation of ice in the chambers. The transformers are located in recesses at the back of the gatehouse, each one mounted on a truck and all served by a transfer table which makes it possible to bring each one around into the gatehouse under the craneway for repairs or loading on cars.

Power House—The power house for the three new units, known as Station 3 C, is merely an extension of the station containing the units of 3 B and 3 A located on a narrow shelf of rock at the foot of the cliff of the Niagara Gorge below the Falls. Its size is restricted by the overhanging cliffs at the back and the deep river in front. The three new units, known as 19, 20 and 21, are at the south end of the power house, spaced at 60-ft. centers. Although of different manufacture, they are similar as to size and capacity and the turbine runners are interchangeable. Units 19 and 20 have Moody draft tubes and unit 21 has a hydraucone draft tube. The scroll cases of units 19 and 20 are of cast steel; that of unit 21 is of plate steel.

The three units operate under a gross head of 217 ft. and use a maximum flow of 3,800 sec.-ft. At the point of maximum efficiency they use about 2,800 sec.-ft. Their nominal rated capacity is 70,000 hp. each, but in actual operation they have developed over 80,000 hp. The electric generators have a capacity of 65,000 kva. at 12,000 volts, 3-phase, 25 cycles, a.c., 107 r.p.m.

The foundations of the new units are of mass concrete carried to a depth of about 35 ft. below mean water level of the river. The draft tubes are cast into this concrete and reinforced where necessary. Above the draft tubes is a reinforced-concrete slab 12½ ft. thick (containing 105 tons of reinforcing bars per

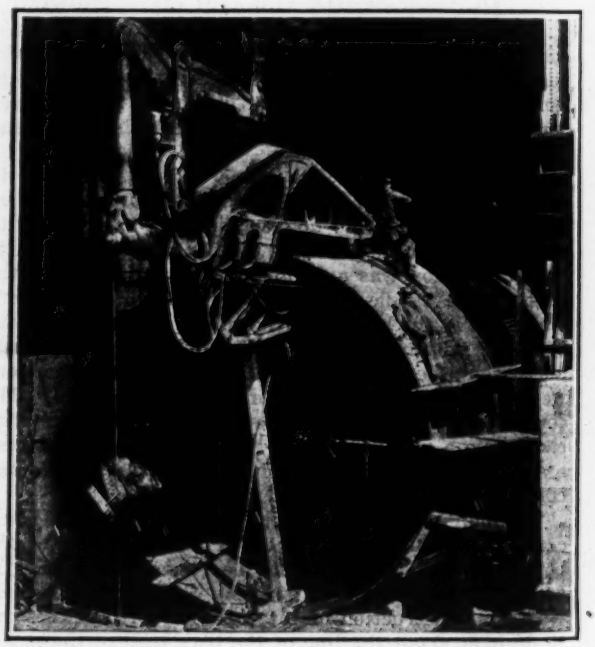


FIG. 4—BULL RIVETER WORKING ON PENSTOCK
Crane-way columns carried on temporary cantilevers to allow working space around penstocks.

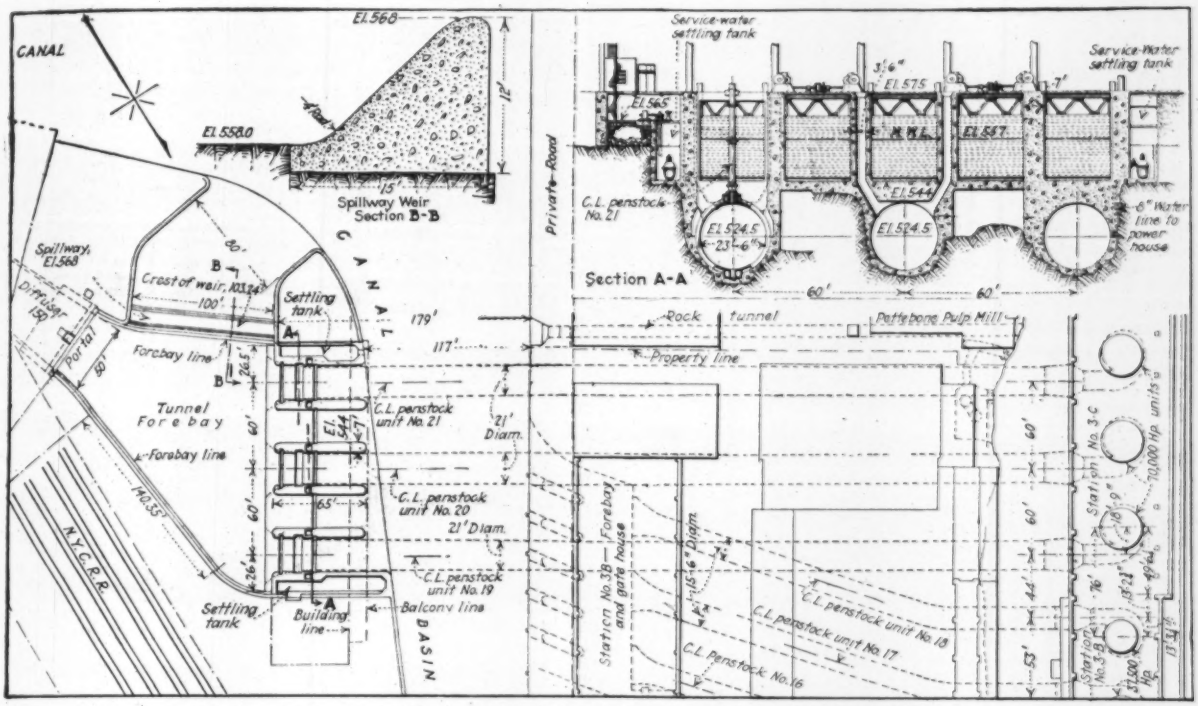


FIG. 5—PLAN OF INTAKE AND SECTION THROUGH GATEHOUSE

unit, of which 86 tons are 1½-in. bars), which support the turbines, generators and scroll cases. The high cones of the Moody draft tubes, reaching to the bottom of the runners, are reinforced with steel bars in the wider part at the base and with both structural steel and bars in the narrow top section. Details are shown in Fig. 7. The method of placing the reinforcing and the support slabs, and of framing the draft tubes to carry the weight of the slabs during construction, is shown in Fig. 8. The lumber for the draft tube forms was all cut as per drawings and partially assembled in the carpenter shop before being sent to the field. All

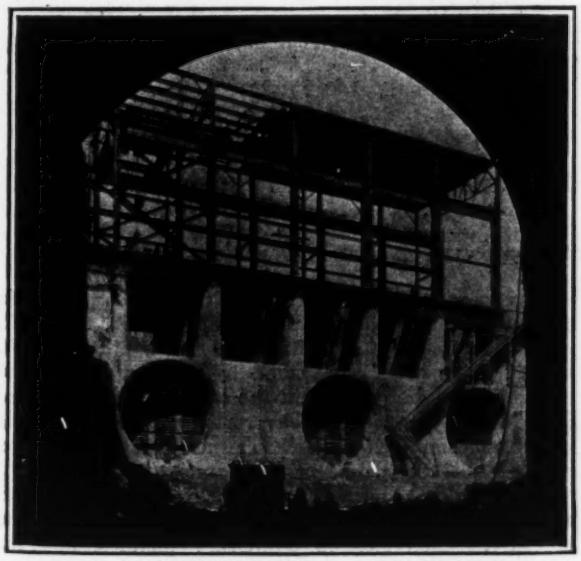


FIG. 6—GATEHOUSE FROM WITHIN THE TUNNEL
Three penstock openings partly closed with temporary stops. Above, five equalizer openings between forebay and canal.

reinforcing steel was bought cut to proper length and bent ready to be placed.

Concrete for the power house was prepared by two 1-cu.yd. mixers located on top of the cliff and delivering concrete through a long chute to the working point, nearly 200 ft. below.

Handling the Equipment—The great size of the new units introduced some interesting problems in handling their parts from cars on top of the cliff to the power house in the gorge and in handling the stators, rotors and runners after they had been assembled in the power house. Some idea of their size is shown by the fact that the revolving part of each unit, carried on a Kingsbury bearing on top of the generator, weighs nearly 600 tons. To handle the sections of these units the two existing 100-ton traveling cranes in power-house 3 B were reinforced by the addition of extra plates to the girder and the substitution of 8 wheels for 4 wheels on the ends of each crane. Each crane was equipped with an additional 100-ton trolley to increase the capacity to 200 tons. For making the 400-ton lifts a beam was provided for each crane to be attached to its two 100-ton hooks and a main 400-ton lifting beam was swung between them.

The "bottle neck" of the whole handling job was from the railroad sidings to and over the edge of the cliff and through the power house door at the foot of the cliff. Crane space and buildings on top of the cliff limited the facilities for making these movements. The equipment consisted of a 50-ton traveling crane mounted on two sets of parallel trusses at 19-ft. centers spanning four switch tracks and extended out over the edge of the cliff by two cantilever trusses. This crane had been erected in 1906 for Station 3 A long before it was realized that such large material would have to be handled over the cliff. Its height above the tracks, its spacing center to center of supports, and the short-

ness of its reach over the cliff were all less than was desirable for handling such large machinery. In order to be sure that the big pieces could be handled by this crane a small scale diagram of each piece, as mounted on a car for shipment, was compared with a similar diagram showing the crane clearances.

Lack of storage space, both at the top of the cliff and down in the plant, made it necessary to schedule the arrival of all shipments. Such a schedule was made for the whole job at the start, and although it was modified as the job progressed it worked out so well that the last shipments were received within two days of the scheduled date of their arrival. The fact that 96 cars were required to ship the main equipment for each unit gives some idea of the amount of material handled.

Canal Enlargement—When the intake tunnel and the gatehouse foundations had been completed the coffer-

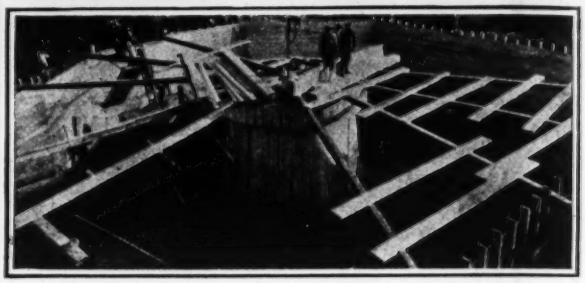


FIG. 8—FORMWORK AND REINFORCING FOR DRAFT TUBES

Unusually heavy bracing in draft tubes due to weight of 12-ft. thick reinforced-concrete slab above it.

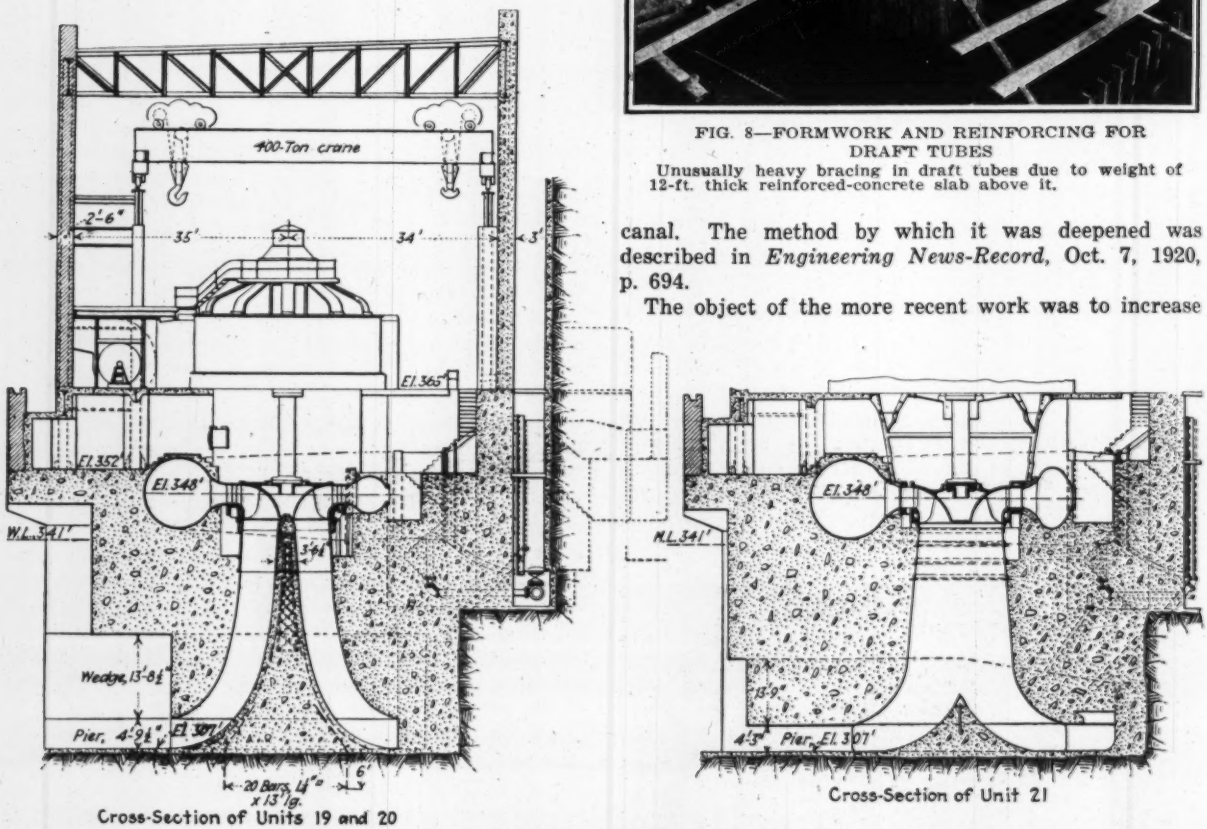


FIG. 7—SECTION THROUGH POWER HOUSE SHOWING THREE NEW UNITS

dam at the gatehouse was swung across the canal to cut it off from the canal basin and another cofferdam was built across the outer end of the canal at Port Day, and water was fed through the tunnel to the canal basin. Following this operation the canal was unwatered through an adit driven to the bottom of the canal from shaft 2 of the tunnel excavation, which in turn drained to the deep tailrace tunnel of the old Niagara plant. This made it possible to deepen and enlarge the canal section in the dry.

In 1920 the canal was deepened to 20 ft. below mean water level, but as this work was done in swift water it left much to be desired in the way of a clean, smooth canal. The method by which it was deepened was described in *Engineering News-Record*, Oct. 7, 1920, p. 694.

The object of the more recent work was to increase the average cross-section area from 1,835 sq.ft. (a minimum of 1,600 sq.ft.) to a minimum of 1,950 sq.ft. with a depth of 22 ft. The average width is 96 ft. and it is so well established by property lines and existing retaining walls that the canal could be widened only in a few places. Measurements taken after the work was completed show that an average cross-section area of 2,055 sq.ft. had been obtained.

Forty-eight thousand cu.yd. of material were removed. Steam shovels were run down to the canal bottom at each end on temporary inclines, and the excavated material was loaded into 4-cu.yd. trucks and taken out of the canal on the same incline and carried

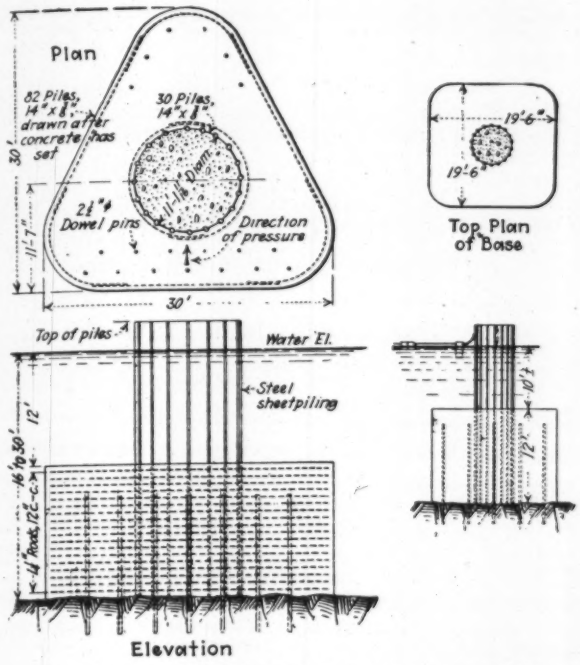


FIG. 9—PLAN AND ELEVATION OF ICE FENDER PIERS AT PORT DAY

to waste dumps. When the work was completed the canal was photographed throughout its entire length in order to have a record of the character of the sides for future use in case repairs are needed, and information as to the under-water conditions is required to determine the extent of the work.

Advantage was taken of the dry condition of the canal to replace three steel bridges with concrete arches, to build new retaining walls where the rock and earth sides were crumbling, and to repair the old retaining walls.

Intake Improvements at Port Day—The work of deepening and improving the intake at Port Day, started in 1920, is being continued in order to obtain a channel at least 300 ft. wide and 20 ft. deep, and to provide better ice fenders. The experimental type of fender piers built in 1920 and shown in Fig. 9 has been found inadequate; a number of the piers having been displaced or overturned in the intervening years. For the new work the outer line of piers has been removed

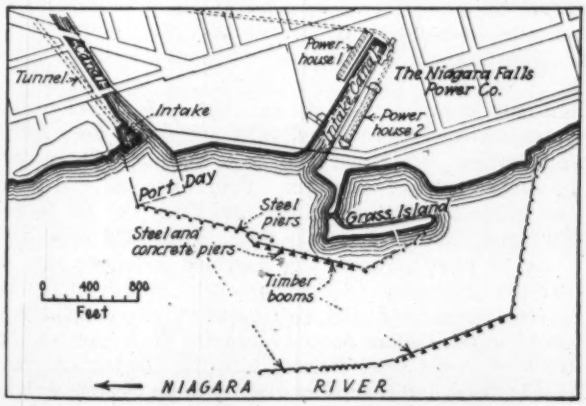


FIG. 10—LAYOUT OF ICE FENDERS AT PORT DAY

and a trench cut through the hardpan which overlies rock on the river bottom all along the line of the outer fenders. The new piers are being built in this trench. They are larger than the old piers and have a considerably greater resistance against overturning. Details are shown in Fig. 9. They are secured to the river bed by 2½-in. dowels split and wedged at the bottom. The height of the wide base is such that tugs can approach the piers without fear of fouling even at low water.

Inside the outer line of fenders will be two new lines to replace the existing ones not in the best location to divert ice which may pass the outer fenders. The locations are shown in Fig. 10.

The under-water excavation is being carried on by drill boats and dipper dredges, the latter loading 4-cu.yd. skips on barges. The barges are towed to an embankment extending out into the river where cranes, mounted on a track, pick up the skips and dump them into 4-cu.yd. trucks for disposal.

Exterior Facing of the Buildings—In order that its buildings and hydraulic structures will not detract

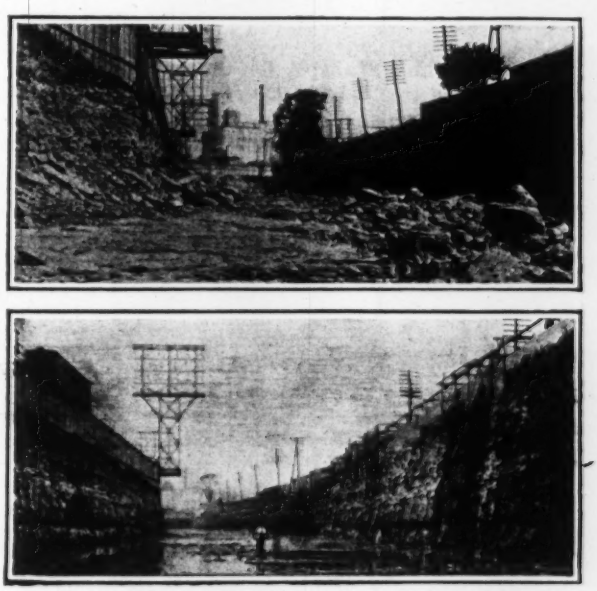


FIG. 11—IMPROVEMENTS IN THE HYDRAULIC CANAL
Above, conditions when canal was unwatered: below, canal cleaned and deepened.

from the beauty of the Niagara Gorge, the power company has adopted a type of exterior finish for them which blends with the neighboring rock cliffs. All exterior walls are faced with natural rock laid up in the roughest manner possible. These walls are not built by the usual methods of building stone walls. Instead, a wooden form is put up for the inside face and the men laying up the wall drop in stones along the outside face and fill in the back with plenty of cement mortar. This gives an inside face similar to a concrete wall but leaves the outside face much rougher than the usual stone wall.

The same type of wall has been used to face the cliffs above the power house to conceal penstocks, ice chutes, and old cuttings. Bays have been built into this wall in which to plant vines and shrubbery to simulate natural conditions.

Hydro-electric Installations—With the three new

FIG. 12—EXCAVATING FOR THE GATEHOUSE AND FOREBAY

units the total nominal hydro-electric installation on the American side is as follows:

Niagara Plant	1,	10 units at 5,000.....	50,000 hp.
	2,	11 units at 5,000 hp.....	55,000 hp.
Hydraulic Station	1,	abandoned	
	2,	1 unit	3,400 hp.
	3 A,	13 units at 10,000 hp.....	130,000 hp.
	3 B,	3 units at 37,500 hp.....	112,500 hp.
	3 C,	3 units at 70,000 hp.....	210,000 hp.
			560,900 hp.

The total water available for use on the American side under the treaty is 20,000 sec-ft. Of this 19,500 sec.-ft. is now available for power purposes at Niagara but, since it is not sufficient for all the above plants, the Niagara plant will be held in reserve, thus making the

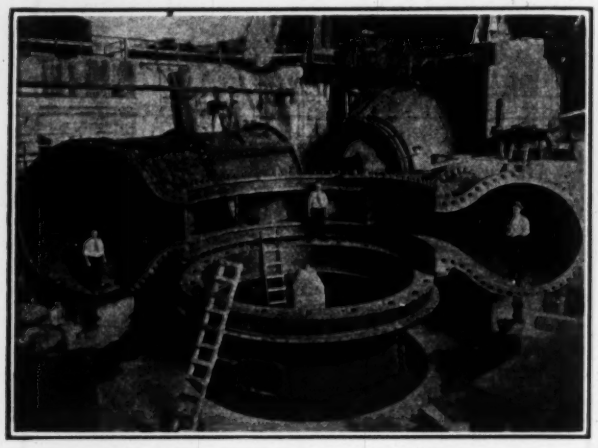


FIG. 13—ASSEMBLING CAST STEEL SCROLL CASE
Johnson valve at the rear.

total nominal capacity of the hydraulic stations on the American side 455,900 hp.

Staff and Equipment—The new plant was built under the direction of the late John L. Harper, vice-president and chief engineer of the Niagara Falls Power Co., George R. Shepard, assistant chief engineer; N. R. Gibson, hydraulic engineer; O. D. Dales, construction engineer; J. A. Johnson, electrical engineer; Louis S. Bernstein, designing engineer; A. Kay, field engineer. The Read, Coddington Engineering Co. was the general contractor.

The turbines for units 19 and 20 were supplied by William Cramp & Sons, and the generators by the General Electric Co. Both the turbine and generator for unit 21 were supplied by the Allis-Chalmers Manufacturing Co. The three 23 ft. 6-in. butterfly valves were also built by the latter company. All three Johnson valves for 21-ft. penstocks were built by William Cramp & Sons.

Articles describing the installation of the three 37,500-hp. units appeared in *Engineering News-Record*, Sept. 23, 1920, p. 582; Sept. 30, 1920, p. 646, and Oct. 7, 1920, p. 694.

Building Details and Equipment of Tribune Tower, Chicago

Round-Corner Windows—Cork Floors—Offset Column Plan—Automatic Elevators—Heating and Ventilating—Power Plant

IN STRUCTURAL and architectural design, fittings and mechanical equipment the 40-story Tribune Tower Building, at Chicago, presents numerous special and interesting features, some of which are outlined in the following abstract of a series of papers read before the Western Society of Engineers by John M. Howells, architect; H. J. Burt, structural engineer; Holmes Onderdonk, manager of real estate; and J. A. Sutherland, mechanical engineer. The structural design will be dealt with more fully in a separate article.

Arrangement of Columns—The column spacing for the lower floors of the Tribune Tower, 100x135 ft. in plan, was determined by the design of the adjacent printing plant building, of which the lower floors were to be an extension. But the architects found that this spacing would not meet the conditions of an office building, so that heavy girder framing was introduced at the fourth floor to carry offset columns for a more suitable arrangement in the upper floors. The main lobby will be three stories in height. On the 25th floor will be a promenade and on the 34th floor an observation room, both open to the public.

Windows and Floors—An original feature is that the windows have round corners, and it is estimated that this feature will pay for the windows in the life of the building, in the total time saved in washing them. Sash locks on the windows are omitted as being useless. All office floors will be covered with cork carpet so that it will not be necessary for tenants to use carpets or rugs.

Fire Protection—At a sacrifice of rental space it was decided to eliminate fire escapes from the exterior and to substitute fire towers. This has never before been done in Chicago, but a fire escape on such a monumental building would ruin the architectural effect. There is no sprinkler equipment, but standpipes and siamese connections are served by a fire pump.

Elevators—In the automatic elevator system, operators will control their cars by push buttons which will not only stop and start the car, but open and close the gates. The cars, equipped with automatic floor leveling devices, will travel 800 ft. a minute. There will be three banks of elevators. Four cars will run from the 1st to the 12th floor, five cars from the 1st to the 24th and one car from the 24th to the 33d floor.

Power Plant—The service provided includes steam at various pressures, hot water, cold water, drinking water, compressed air, refrigeration and ventilation. Coal for the boilers flows by gravity from cars on the track at street level directly into the 500-ton concrete coal bunkers and thence by gravity to an electric weighing larry which discharges into the hoppers of the

chain grate stokers. Bunkers are designed with emergency storage space from which coal can be transferred through chutes onto a bucket conveyor for transfer to the gravity bunkers. Coal can also be delivered at the boiler room floor from cars on the narrow-gage tracks of the Chicago Tunnel Co.'s system and be transferred by bucket conveyor to the gravity bunkers. Ashes are handled by a steam jet ejector discharging into concrete storage bunkers directly over the tracks of the tunnel. The bucket conveyor can also be used in an emergency to carry ashes from the ashpits to the ash storage bunker.

The depth of the boiler room requires sewage ejectors; these are of the dry-basin type with duplex pumping units. The boiler room being on the tunnel level, would permit flooding of the lower portions of the building should water enter the tunnel. Flood gates are therefore installed on all door and ventilating openings from the tunnel into the building. These gates are motor operated and arranged with both automatic control and remote manual control.

Heating—The heating system is of the vacuum return type. Steam is fed down from distribution mains in the mezzanine at the 24th floor to all radiators down to and including the first floor. The heating above the 24th floor is up-feed with vacuum returns gathered together in the 24th mezzanine and returned in a separate line to the vacuum pumps. The substructure and the printing plant building operate on separate distribution lines with separate returns to the vacuum pump.

Ventilation—For ventilation of the substructure, air is taken from the adjacent tunnel of the Chicago Tunnel Co., with an auxiliary intake from the space below the upper Michigan Ave. level; this air is heated, washed and supplied to all the spaces below the upper Michigan Ave. level, the street being a double-deck structure at this point. Exhaust ventilation is provided in all these spaces and the air is discharged well above grade in the alley. Special ventilation is provided where space is to be used for editorial or working spaces. Toilets are provided with exhaust ventilation.

Plumbing—The arrangement of the plumbing stacks provides for lavatories in every room that might be divided into rental spaces and for toilet and drainage as required. All the drainage of the superstructure is taken directly to the sewers, while the substructure spaces are drained to ejector pits having motor-driven centrifugal pump ejectors of the dry-pit type.

Sub-drainage is provided under the lowest floor levels to relieve upward pressure on the slabs, and this drainage is connected through sumps to one of the main ejectors. As a rule the tops of the vent pipes from the plumbing stacks are not exposed on the promenade roofs of the main building, but the open ends of these vents are set in recesses in walls or in the parapet wall with large bronze gratings to conceal them.

Water Service—Hot and cold water are distributed through three separate systems, providing for as many separate levels and pressures. These systems are provided with tanks at the 15th and 26th floors for gravity feed down; the lower tank supplying down to the first floor and the upper one supplying down to the 14th floor. The tower water service is a pressure system with a combined pump and air compressor operating through a storage tank to supply the water to the highest point. Hot water is furnished by a separate heater at the 26th floor level in conjunction with this pressure system. In the lower levels, the hot water is provided through instantaneous and storage type heaters arranged in series with separate units for each high and low level system.

The entire building is supplied with filtered, ozonated and cooled drinking water. Water cooling is done with CO_2 compressors which have spare capacity for future use to cool a small amount of air for summer ventilation in special rooms. The drinking water is treated with ozone in filling the system, with a bypass so arranged that the water standing in the system can be retreated or re-ozonated as occasion requires.

Compressed Air—There are two air compressors, with an auxiliary line from the compressor plant in the old plant building. Air is extended to all switchboard, motor and printing press locations, for cleaning and to the boiler damper regulators, thermostatic control valve on "vento" heaters and to elevator door-operating devices.

International Railway Between Italy and France Proposed

Paris Correspondence

JUST AFTER the armistice in 1918 there was a meeting between the French and Italian governments regarding the construction of a new branch railway line between Oulx in Italy and Briançon in France, there being no international rail connections between Mont Cenis in the north and the P.L.M. Mediterranean line in the south. Another similar branch is under construction between Nice and Coni in Italy but it has been held up by the war and little progress has been made on the French side. One or the other, or both, of the projected lines are now to be pushed forward.

The line from Oulx to Briançon will have a length of 27.2 kilometers, of which 15.4 kilometers are on Italian territory and 11.7 kilometers on French soil. By its construction Marseilles in France and Turin in Italy will be linked up by a short line railway which will immeasurably relieve the already encumbered line of the P.L.M. via the Mediterranean coast.

Tunnel construction on the Oulx-Briançon line will have a length of 8 kilometers but presents no particularly difficult engineering problems. Figured in lire the expenses of construction are estimated as 36,364,000, of which 19,400,000 will be applicable to the Italian section and 16,964,000 for the French section.

This and the Nice-Coni line referred to are virtually the only new railway constructions in view in France at the present time and with the rapid development of feeder motor bus lines for freight and passengers it is hardly likely that any great amount of railway building will take place henceforth in France.

More Active Building Expected in Canada

While a relatively small amount of new construction for 1925 is definitely booked in Canada prospects are regarded as much better than in 1924 according to the Department of Commerce. The year 1924 closed with more confidence as to the future, and with the belief that general conditions were more established. The two elections, the one in the United Kingdom and the other in the United States in the autumn of 1924, increased confidence. This has made easier the borrowing of money in the United States for construction in Canada. Again, much of the excess of construction due to the war has now been absorbed into use.

Hydraulic Surveys Aid Design of Highway Bridges

Exhaustive Field Investigations, Reports and Photographs Basis for Design of Water-Course Crossings in North Carolina

By P. K. Schuyler
Assistant Engineer, North Carolina State Highway Commission

BEFORE the North Carolina State Highway Commission was reorganized in 1921 all location was done under the district engineers. One of the first steps taken was to centralize this work, placing a principal locating engineer in charge of location work throughout the state. The structure recommendations as turned in, when the work was done under the district engineers, were often found not to be complete or uniform, for the man who made them was not familiar with bridge design and could not appreciate just what information was required, so it was decided to create a field organization under the bridge engineer and to call it the structure survey department. This department was to make all surveys and recommendations for bridges, culverts and channel changes. Some of the structures built by the state previously are seen as being too large, and likewise there are some structures rather small. By having structure survey recommendations made under a uniform system by specially-trained men it is believed such errors have been reduced and considerable money saved to the state.

An assistant engineer is in charge of the work, having under him five field parties. Three of these parties consist each of a chief of party and a rodman, using a Ford car for transportation. Each of these parties is assigned to cover structure surveys in three districts, the state having nine districts. The chief of party of this work is required to be familiar with the design of structures and their relative economy, as well as to have experience on actual construction. He must also have a knowledge of highway location as he is frequently called upon to recommend relocations of lines at bridge sites. A fourth party equipped with a hydraulic testing drill carried on a truck trailer is in charge of a geologist. His work consists in obtaining foundation data at sites where the regularly-equipped field parties are unable to secure satisfactory foundation with earth augers. A fifth party is given special assignments.

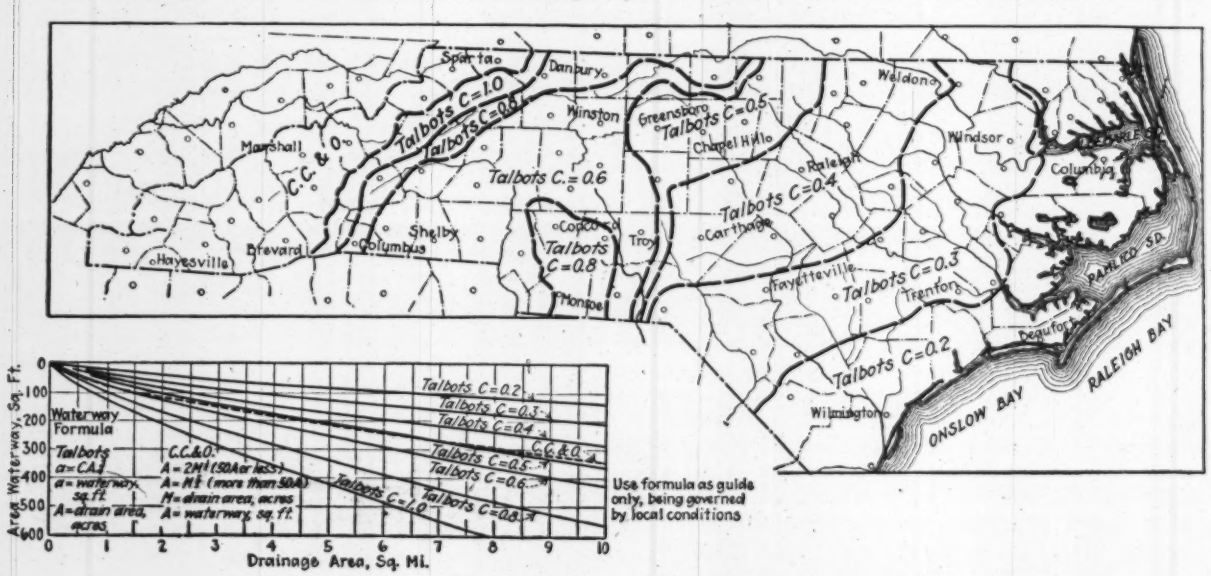
As soon as possible upon the completion of the road location a structure survey party is sent over the project to make the structure survey. The recommendations made by the field party are checked by the assistant engineer and the reports submitted to the bridge engineer, who in turn notifies the road department as to the grade over structures and the sizes of structures. Inspection reports containing the structure recommendations are then turned over to the designing engineer who has plans prepared.

Rainfall and runoff formulas in general are compared, and for culverts and small bridges the use of the formulas indicated on the chart herein shown has been settled on. The C. C. & O. formula listed was used by the C. C. & O. R.R. on its mountain construction and is found to hold more closely than Talbot's formula for the portion of the state west of the Blue Ridge Mountains, this formula being an adaptation of Wentworth's formula. On all structures the drainage area is determined from field inspection or existing maps and the waterway required by these empirical formulas figured. The waterway is then increased or decreased to suit local conditions. By applying this method no radical error or inconsistency in the size of waterways can be made. On the large streams where gaging records are available a separate study and hydraulic report is made for each proposed bridge.

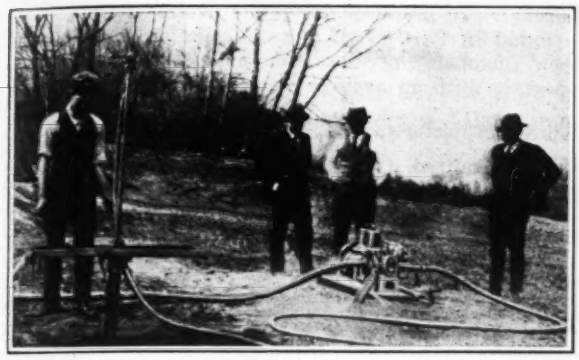
After considerable study and experimenting with various types of boring outfits the following methods of obtaining foundation data have been settled upon:

(1) Earth auger for light work where rock is near the surface and there is no question as to the thickness of strata.

(2) Drill to be used on jobs when the nature of rock and thickness of strata are questionable.



MAP OF NORTH CAROLINA SHOWING RUNOFF COEFFICIENTS USED IN HYDRAULIC COMPUTATIONS



HYDRAULIC DRILL IN OPERATION

(3) Ordinary well drill to be used on important work where there is considerable amount of rock drilling to be done.

All field parties are equipped with an earth auger and 3 ft. 6 in. lengths of ¾-in. pipe. These augers give good results provided the rock is not covered with too much overburden. If this is the case, gravel is liable to be mistaken for rock. We use 2-in. augers.

Two hydraulic testing drills have been purchased. They are wash boring outfits in light and compact form, and will drill gravel, soft rock and even hard rock. Water for the washing operation is supplied by a 5-hp. aluminum pump and engine whose combined weight is but 110 lb., making it easily transported. We have had these drills in operation for the past year and a half.

On our largest bridge sites the work has been let to well drilling operators at about $3 per foot. It is found that this heavier drill is more suitable for hard drilling than the lighter outfits, but it is impractical to get a well drill to some inaccessible sites and at these places the hydraulic drill, which can be carried in by hand, is used.

When preliminary data are at hand a bridge inspection form is made out for each bridge. It has been found that a photograph is of great value, enabling the designing engineer to visualize field conditions. A culvert report is made for each culvert. Field parties are required to take extreme care as to the accuracy and neatness of their reports, the work of making up reports consuming almost as much of the time of the chief of party as the actual field work does.

The size of waterway required for the larger structures as previously mentioned is based on a careful hydraulic study. Fuller's formula is used to determine the expected flood flow.

$Q = CA^{0.8}(1 + 0.8 \log T)$ where

Q = Max. average 24-hour rate of flow in sec.-ft.
C = Coefficient which is constant for the river at point of observation.
A = Drainage area in square miles.
T = Number of years in the period considered.

Values of A and C are given in Table I.

TABLE I—VALUES OF "A" AND "C"

	A	C
Roanoke River at Roanoke, Va.	388	75
Dan River at South Boston, Va.	2,750	41
Neuse River at Selma, N. C.	1,175	32
Cape Fear River at Fayetteville, N. C.	4,493	63
Yadkin River at North Wilkesboro, N. C.	500	85
Yadkin River at Salisbury, N. C.	3,400	88
Catawba River at Morganton, N. C.	758	103
Catawba River at Rock Hill, S. C.	2,987	99
French Broad River at Asheville, N. C.	987	65
Mill (North Fork) River at Pinkbed, N. C.	24	60
Mill (South Fork) River at Sitton, N. C.	41	81
Little Tennessee River at Judson, N. C.	675	142
Tuckaseegee River at Bryson, N. C.	662	124
Hiwassee River at Murphy, N. C.	410	101
Valley River at Tomatla, N. C.	106	117
Nottenly River at Ranger, N. C.	272	47

As an indication of the extent to which research goes, the following extract from a hydraulic report is cited:

Study of Waterway Required at Pee Dee River Bridge

CULVERT NOTES

Proj. No. 513

Date. June 22, 1923

Chief of Party. W.S.Winslow

Sta. 603 + 60

Size. 3 x 3 Skew. 90°

Drainage Area. 15 Acres

Obtained. Field Observation

Formula Applied. Talbot's c = 0.7

Area Waterway Req. 6.1 sq ft.

Branch flows Lt. to Rt.

Elev Sta. 603 00 = 481.4

Dist. bed below Sta. = 1.1

Actual Elev bed = 480.3

Dist bed should be lowered = 0.4

Floor Culvert to be Elev = 479.9

Subgrade Elev = 484.3

Are Piles Required No.

Approx. vel. of flow = 5 ft. per sec.

Data on other openings on the same branch Long narrow gulley 2000' x 300'. Dig ditch from 75' Rt. Sta. 602-85 to inlet of box. $\frac{80x2x1}{27}$ = 6 Cu.Yds.

STANDARD FORM FOR CULVERT NOTES
On the reverse side space is given for sketching any channel changes.

at Pee Dee—All the available data concerning this river have been obtained and tabulated. The following sources of information were searched: (1) N.C.G.S. reports; (2) U.S.G.S. reports; (3) Weather Bureau data; (4) Data on file with Carolina Power and Light Co., and (5) Files of Mr. Saville, state hydraulic engineer.

TABLE II—RELATION BETWEEN FLOOD TO BE EXPECTED IN A SERIES OF YEARS AND THE AVERAGE YEARLY FLOOD

Time in Years	Ratio of Largest Flood "Q" to Average Yearly Flood
1	1.00
5	1.56
10	1.80
25	2.12
50	2.36
100	2.60
500	3.16
1,000	3.40

The only data of value are those at Salisbury for only at this station have flow measurements been made at

the higher gage readings. Records at Salisbury extend over a period of 28 years. From these records the average yearly flood at Salisbury is found to be 59,000 sec.-ft. This discharge when substituted in Fuller's formula using $T = 1$ gives a value of 88 for the coefficient C, this being the method of obtaining the tabulated values shown in Table I. The yearly flood at Pee Dee is now obtained from the formula using $C = 88$, T = 1, and $A = 6{,}869$. This yearly flood is found to be 103,400 sec.-ft. From Table II the 100-year flood is 2.6 times the average yearly or $2.6 \times 103{,}400 = 268{,}840$ sec.-ft. And from Table III the crest of such a flood will be $1.15 \times 268{,}840 = 309{,}166$ sec.-ft.

In the light of past records this is the flood that is predicted to occur once in every hundred years and is the flood that the structure will be designed for. Knowing the flood to be designed for, Kutter's formula is used to compute the area of waterway required. A thorough and practical discussion of this formula will be found in Part IV of the "Calculation of Flows in Open Channels" of the Miami Conservancy District reports. With an average velocity of 6 ft. per second an area of waterway of $\frac{309{,}166}{6} = 51{,}528$ sq.ft., the amount required.

The cost of maintaining a structure survey party in the field was $515 per month for the year 1923, which included salaries, living, car expenses and overhead. The total cost of operating the structure survey department was $2,590 per month for the year 1923. During most of this period four field parties were kept out. On a $275,000 bridge project the costs of making surveys and studies such as described above was $1,900, or 0.007 per cent of the estimated cost of the structure. The average cost of these surveys during 1923 over all the work done was 0.075 per cent of the estimated cost of the structures.

PROJECT NUMBER 835

STATE OF NORTH CAROLINA

STATE HIGHWAY COMMISSION

BRIDGE INSPECTION REPORT

Bridge known as Broad River Bridge.

Over Broad River Center-Line to be Sta. 753+20

to between Bineyrill Township, Henderson County,

and Township, County,

on Route Number 10 Type of road to be built Hard Surface

Inspected by P.K.Schuyler Date 12-14-22

Accompanied by B.H.Conner

Span recommended for new structure 4 @ 40' = 160'

Type of Bridge recommended R.C.Deck Girder

Skew 90° Roadway 20'

B.M. (Description and elevation) Tack in 12" Locust right Station 753+90 Elev. 1515.51

Will it be necessary for the Contractor to build and maintain a temporary crossing? No.

Are piles required? No.

Is stream navigable (War Dept. definition)? No.

Exceptional items to be shown on the plans:

1. Use Mass Piers as stream is swift and carries heavy drift.

Size of drainage area ..... sq. mi. ..... acres. Obtained from .....

Character of drainage area—level, rolling, hilly, sand, clay, wooded, cultivated, etc. .....

Area waterway required ..... sq. ft. Formula applied .....

Area waterway provided by recommended structure ..... sq. ft.

Velocity of flow ..... ft. per sec. (Ordinary water.)

Approx. velocity of flow ..... ft. per sec. (Max. H. W.)

Highwater elevation ..... Year .....

Authorities for H.W. .....

Character of water in the stream .....

Are marine borers present or liable to appear? .....

Must existing bridge, abutments or fill be removed to provide unobstructed waterway? .....

Is riprap required; if so, where? .....

Nearest shipping point ..... on .....

Distance from shipping point to bridge ..... miles.

Method used for taking borings .....

Depth foundations should be carried below stream bed ..... ft.

Footings to be founded on .....

Do you consider information shown as to foundation conditions satisfactory? .....

REMARKS* .....

*Under Remarks, give data on other bridges over the same stream.

FORM FOR REPORT UPON PROPOSED NEW BRIDGES

This is a 4-p. report with interior pages of cross-section paper for sketches showing existing conditions.

TABLE III—RELATION OF FLOW AT CREST STAGE TO "Q" OR AVERAGE 24-HOUR RATE

Q (Crest) $= Q(1 + 2A^{-0.3})$

A, Sq.Mi.	Ratio of Crest Flow to Average 24-Hour Flow
1	3.0
10	2.0
50	1.61
100	1.50
200	1.41
500	1.31
1,000	1.26
5,000	1.16
10,000	1.13

Harbor Works at Fort Nelson Damaged

More than half a million dollars' damage was done to the Canadian government's uncompleted harbor work at Port Nelson, Hudson Bay, by a storm which occurred in November, according to reports which recently reached the Canadian capitol at Ottawa. Considerable equipment, including two dredges and several smaller craft, was carried away during the storm.

Building the Lake Humphreys Concrete Arch Dam

Work Carried on During Winter Despite High Altitude—Cost of Protecting Concrete Estimated—Arch Design Figures—Deflection of the Arch Under Load Measured

By Carl A. Gould
Denver, Colo.

LAKE HUMPHREYS concrete arch dam is located in Colorado, on Goose Creek, a tributary of the Rio Grande, in the San Juan Range of the Rocky Mountains at an elevation of 9,000 ft. above sea level. The drainage area above the dam is 51 square miles. In this region from October to May heavy snow and extreme cold are to be expected and temperatures of 20 deg. below zero are not unusual. Weather conditions vary within a wide range from day to day and the wind blows during some part of each 24 hours. Under such circumstances it is easy to imagine the difficulties attending the continuous operation of concrete construction work.

FIG. 1—EARLY STAGES OF CONSTRUCTION
Flume carrying stream past the site; form yard in the foreground and concrete plant at upper left.

The investigation and accurate survey of the project was started in July, 1922, and the actual construction work began Oct. 27, 1922. The excavation work was continued until Dec. 22, 1922, during which time a flume was built to carry the water of Goose Creek past the dam site at an elevation of 25 ft. above the canyon bottom. Work was resumed March 8, 1923, when the ice was chopped away in the canyon and the foundation prepared for the concrete base.

The first concrete was poured April 6, 1923, and the work in the canyon continued to May 9, 1923, when all equipment had to be removed on account of high water. The work on the spillway was started May 10, the first concrete being poured June 30, and the spillway completed Aug. 28, 1923. The pouring of the concrete in the arch section across the canyon was again started on Sept. 7 and was carried on continuously until the completion of the entire project April 2, 1924. The actual time consumed on the total construction work, pertaining to excavation and pouring of concrete, was 447 days.

In order to get construction plans under way, an assumed datum was used in making the surveys; later, the project was tied in with a U.S.G.S. bench mark which established the following relation: Map contour 2,010 = U.S.G.S. El. 8,950; therefore the top of the dam is 8,955 ft. above sea level.

The quantities involved in the construction of the dam and spillway were as follows:

	Cu.yd.
Earth excavation	381
Rock excavation, dry	2,669
Rock excavation, wet	391
Concrete, spillway gravity section	1,275
Concrete, arch section	2,886
Reinforcing	20 tons

Foundation—The rock at the dam and spillway sites is a diorite porphyry, seamy at the surface but pinched out to practically solid formation at depths varying from 6 to 30 ft. Where there appeared to be any possibility of seepage after the lake was filled, grout pipes 1½ in. in diameter were embedded in holes drilled across the seamy structure, and cement grout was forced into the pipes under a pressure of 100 lb. This pressure was kept on the grout pipes from 30 min. to one hour.

Tests of the compressive strength of the rock in the abutments gave an average of 19,840 lb. per sq.in. for 2-in. cubes and 15,480 lb. per sq.in. for a prism 2x2x6 in.

In excavating the old stream bed, several large boulders were found and under the boulders were pockets in the rock which made it necessary to excavate for foundation to a point 11 ft. deeper than is shown on the accompanying drawing.

The added excavation at the base of the dam permitted the moving of the discharge pipes 5 ft. lower than shown, thus placing the center of the pipes 75 ft. below the spillway crest.

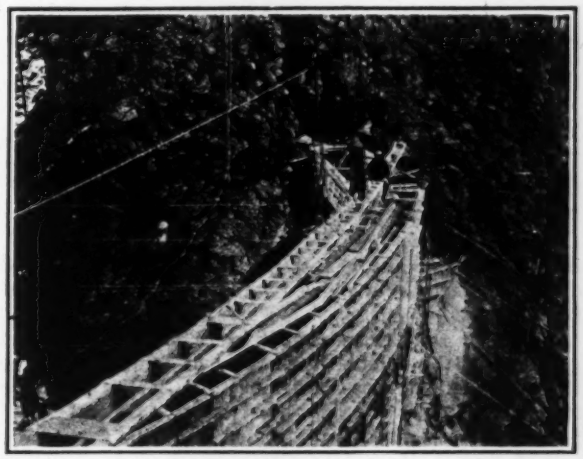


FIG. 2—SETTING AND SECURING FORMS TO TRUE LINE

The excavation of the sides of the canyon was made so that the bearing line of concrete against rock would be along a radial line of the arch, in general, and in no case was the angle between the radial line and rock face, at concrete-rock contact, allowed to exceed 30 deg. at the downstream point of contact, and 20 deg. at the

upstream point of contact. In all cases the rock face was cut away until a solid bearing surface was exposed. Steps were excavated in the rock face to present a nearly horizontal surface to the vertical pressure. Wire brushes, and a stream of water under pressure, were used to give the rock the final cleaning to receive the concrete.

Concrete—The sand, gravel, and cement were so proportioned as to fill the voids, approximately a 1:2:4 mixture. Hydrated lime in the proportions of 7 lb. to each 100 lb. of cement was used in the top 30 ft. of the arch. All sand and gravel were washed and screened and no material was allowed which had over 3 per cent silt and dirt.

Plums of solid washed rock were allowed up to 20 per cent of the volume in sections of concrete greater than 6 ft. in thickness, no stone to be larger than two men could lift.

Concrete was placed wet, spaded along the forms, and preceded on the rock face with a grout wash.

Horizontal Building Joints—Horizontal building joints were permitted at intervals of not less than 12 ft. The surface of old concrete was removed with steel and hammer to a depth of from 2 to 6 in. in order to dispose of all laitance and collections of pure cement. Where the concrete was moved along in the form with shovels there was a tendency to separate the aggregate from the cement, especially near the top of the form, and this sometimes caused a pocket of cement at the top which cracked readily during the setting period.

The surface of the old concrete was watered and covered with thick cement grout before a new concrete section was placed.

Vertical Contraction Joints—Vertical contraction joints were placed at intervals of 45 ft. measured along the upstream face of the arch. The V-type joint was used, the Vs being spaced at 5.5-ft. centers. The faces of the joints were painted with two coats of asphalt and a ½x6-in. strip of prepared paving expansion joint material was used in each vertical joint, being placed in the downstream face of a joint V.

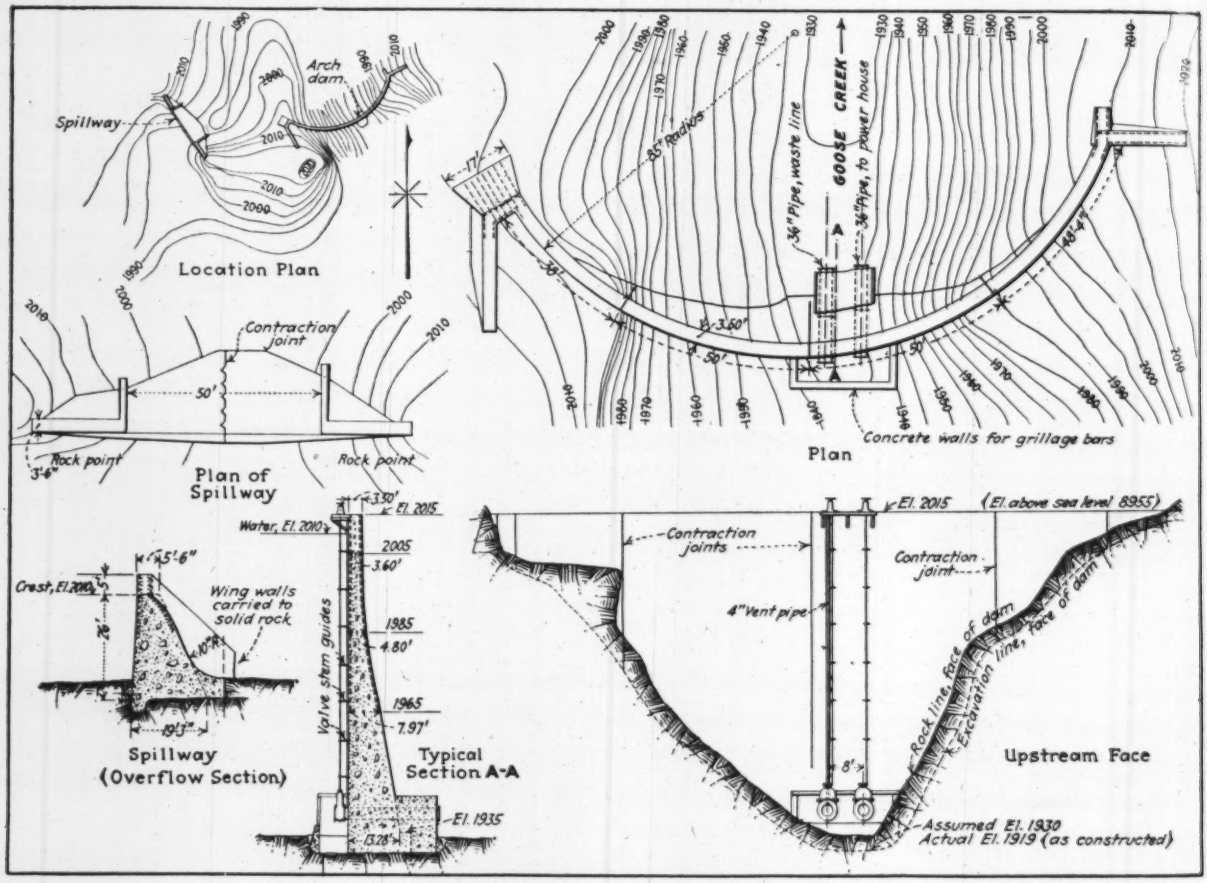


FIG. 3—DETAILS OF DAM AND SPILLWAY

Reinforcing Steel—The top 50 ft. of the arch and the top 15 ft. of the spillway were reinforced in order to give added strength to resist ice pressure. Deformed bars were used and were placed 8 in. from the upstream face and 6 in. from the downstream face and in no case were the steel bars allowed to pass through contraction joints or to enter the rock.

Forms—The forms were of 2-in. material, with 3x6-in. girths, and made up in sections 6 ft. wide and 12 ft. high. The sections were bolted together and raised as the construction proceeded. They were plumbed with guy wires and held together with 14 strands of wire, 4 No. 12 gage wires to the strand.

Discharge Pipes and Valves—Two 36-in. diam., ¼-in. metal, riveted steel pipes were placed 16 ft. above the base of the dam; one line for waste discharge and one line to power house. One 6-in. angle iron was riveted to each pipe to permit substantial anchorage in the concrete.

The waste pipe was equipped with a 4-in. vent pipe on the upstream face of the dam leading from a point just back of the valve up to 4 ft. above the lake surface. One 36-in. gate valve was placed on the upstream end of each pipe.

The trash racks were made up in sections 2 ft. wide by 7 ft. long, supported on 6-in. I-beam framework securely anchored in the concrete walls. The spacing of the bars over the power line was 3⅜ in. and over the waste line 9 in. The bars in the vertical screens were of ⅜x3-in. steel and in the top screens of ⅜x2-in. steel.

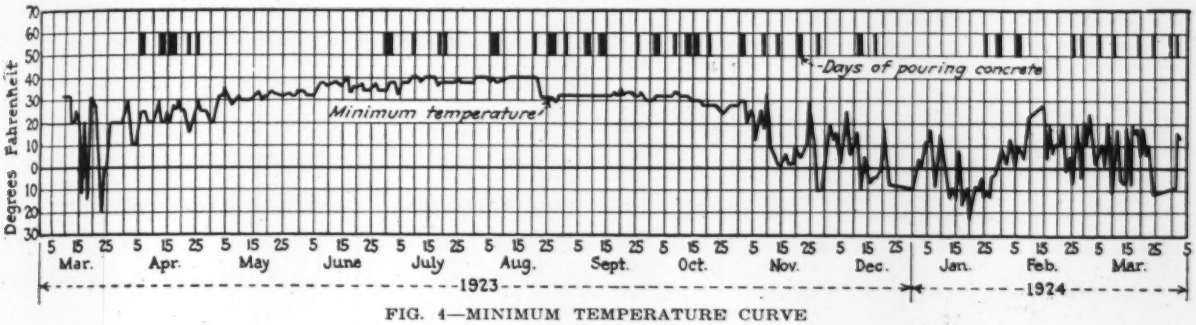


FIG. 4—MINIMUM TEMPERATURE CURVE

Railing—The railing was made up from 1½-in. pipe which also served as conduit for the electric wiring along the top of the dam. All exposed iron and steelwork was given two coats of preservative paint.

Protection of Concrete from Low Temperature—Protecting the concrete from extreme cold weather, which was usually attended with wind, was one of the large items in the cost of construction. The following methods of protection were used and during extremely cold weather all of the methods were in operation. The

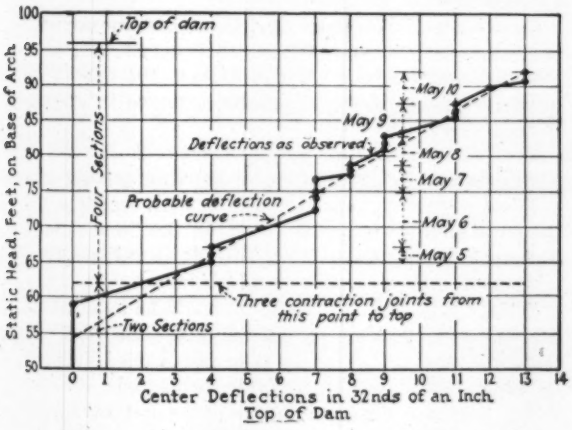


FIG. 5—DEFLECTIONS OF ARCH UNDER LOAD

average size of concrete block to protect was 12 ft. high and 45 ft. long: (1) A furnace 10 ft. wide and 20 ft. long, containing 400 lin.ft. of 1-in. pipe over the fire, covered with ⅜-in. boiler plate was fired continuously and all the material (with exception of cement and lime) was passed over this heater on the way to the mixer. The water used for mixing was passed through the pipe, over the fire. The furnace was fired with spruce and pine wood. (2) The forms were completely covered with heavy canvas which was made up in single sheets 50 ft. long. (3) Eight oil heaters were placed under the canvas at the base; three stoves on each side, and one at each end, of the form. (4) Eight fire pots, 30 in. in diameter, were hung about 8 ft. below the base of the canvas and fired with wood blocks; the pots were spaced, three each side, and one at each end. (5) Fires were kept burning in the bottom of the canyon, on each side of the dam. The heat traveled up the side of the dam and passed, with the wind, over the top. (6) By far the most effective method used was warm water. As soon as a section of concrete was poured the top of the concrete in the form was kept flooded with warm water. The forms were kept open enough to permit the dripping of the warm water down the outside of the form. The furnace was operated for heating the water.

This flooding was carried on from 48 to 72 hours after the concrete was poured. Men were employed to keep constant watch of the protective measures.

Computations—The established formula $p = \frac{qr''}{t}$ was used for the arch design where:

p = stress in unrestrained arch at any elevation
q = unit load taken by unrestrained arch at any elevation
r'' = radius of arch at any elevation, measured to the upstream face
t = thickness of arch at any elevation.

r'' in this case was constant at 85 ft., p = 30,000 lb. per sq.in.

The following table gives the thickness as computed and as built:

THICKNESSES OF DAM AS COMPUTED AND AS BUILT

Head of Water on Dam Ft.	Theoretical Thickness of Arch at Corresponding Elevation Ft.	Thickness of Arch as Built Ft.
91	16.11	17
85	15.05	17
80	14.17	16
75	13.28	16 & 13.28
70	12.39	12.39
65	11.51	11.51
60	10.62	10.62
55	9.74	9.74
50	8.85	8.85
45	7.97	7.97
40	7.08	7.08
35	6.20	6.20
30	5.31	5.31
25	4.43	4.80
20	3.54	4.30
15	2.66	3.90
10	1.77	3.70
5	.89	3.60
0	.00	3.50
Top of dam 5 ft. above water line, coping not included		3.50

Central angle of arch = 124 deg. 26 min.
Ratio of slenderness = At top - - - 53.2
At mid-height.....12.6
Reinforcing, where used, = 0.424 of one per cent of volume of section.

Ratio of waterway opening in trash racks to area in discharge pipes:

Waste discharge.....16.2:1
Power line.....16.5:1

The spillway design and shape are based on Bazin's experiments for vertical upstream face. The bucket radius is empirical and is taken as 10 ft. in this case.

Observations on Filling of Lake Hnmphreys—Observations of the center deflection of the dam were made with a transit. For all practical purposes the deflection of the top of the arch, at the center of the dam, may be considered as a gradually increasing deflection. The filling of the reservoir was completed in ten days during which time the temperature remained practically constant and the average temperature of the atmosphere

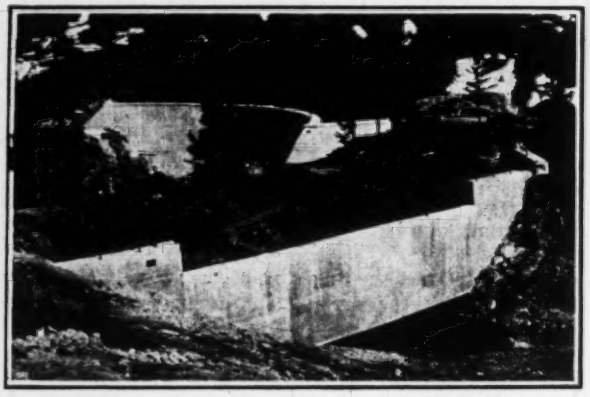


FIG. 6—COMPLETED DAM AND SPILLWAY

was approximately the same as that of the water. It is believed that stresses due to temperature changes had very little effect on the shape of the deflection curve shown in Fig. 5.

As the observations were taken with a transit, it must be borne in mind that the personal equation may have entered into the results.

A study of the deflection curve in Fig. 5 reveals that there might possibly be a slight (not sudden) deflection of the arch at intervals. While this is not here stated as fact, still it occurs to the author that it is a question which should receive some thought and study in the future.

Of course, the arch is subjected to a gradually increasing pressure and, with a perfectly constructed arch the position of the arch would respond to this gradually increasing pressure in proportion to the pressure. But in our field construction we do not have a series of contraction joints all opening by the same amount during the contraction of a structure, neither can we expect them all to close to the same tightness during the expansion of the structure until the structure has assumed the stresses of a monolith. Consequently the variation in openings of the contraction joints and the resistance to compression of the joint filler may have a tendency to retard the deflection of the structure at intervals during the filling of the reservoir and result in an irregular curve of deflection as shown in Fig. 5.

Slight hairline cracks developed in some of the sections, but in only one locality did these cracks form a stream. On the westerly end of the dam, about 35 ft. up from the base, a setting crack threw out three little streams, ¼ in. in diameter. After the lake had been filled for seven days these streams stopped and the flowing took the form of a seep. All of the other cracks in the masonry developed only seeps which are gradually drying up.

The three vertical contraction joints, in the arch, and the one vertical contraction joint in the spillway section leaked to some extent but in no case developed streams which shot from the face of the dam. The closing of the joints was gradual as is evidenced by the gradual pushing out of the asphalt filler which in some places was as much as 2 inches.

No seepage developed at the junction of the concrete with the rock but there is a very slight seepage in the rock along a seam on the easterly bank of the canyon about 50 ft. below the dam and it is believed this water enters the rock at some point up the canyon from the dam site.

The formation between the spillway section and the arch section was undisturbed and this portion developed a leak at the east end of the spillway which flows about 2 gal. per minute. The total leakage is estimated at 4 gal. per minute.

Construction Operation—Sand and gravel were hauled by team, in two-wheel dump-carts, a distance of 1,400 ft. Water was furnished by a gravity system 1,500 ft. long. A 9 cu.ft. mixer, 8-ft. gravel screen, standard concrete chutes, two-wheel dump-carts, and barrows were used on the concrete work. The rock was drilled with jackhammers supplied by a 105-ft. air compressor. A power saw was used for the wood; all power was furnished by tractors.

Flexible spouts and short sections of chute were used to distribute the concrete in the forms. Electric light was available for night work, using 60-watt lights around the mixer and a 500-watt flood light for the canyon work. All other points of operation were lighted by gasoline torches.

Conclusions—Weather conditions are in no way an insurmountable obstacle in concrete construction work.

Where aggregate is easily obtained, the use of plums to make volume is only an added expense in structures of this shape and size.

Vertical contraction joints, spaced 45 ft. apart, do not eliminate the formation of hairline setting cracks.

Flooding newly poured concrete with warm water is the most effective means of keeping the frost out of the structure during the setting period; it reduces the formation of setting cracks to a minimum.

Winter concrete construction should be avoided unless the value of the time saved will offset the cost of protective measures, which in this case varied from $1.40 to $2.00 per cu.yd. of concrete protected.

Fig. 4 shows minimum temperature and days concrete was poured.

The total cost of the arch dam and spillway construction was $145,000.

Power—Data have been obtained for the construction of pipe line, power house, and transmission line; this part of the project will not be built until the demand for the power exists. At present the lake is used for pleasure purposes and for trout culture.

The average flow of Goose Creek is 45 sec.-ft.; the minimum flow is 23 sec.-ft. and the maximum flow 1,000 sec.-ft. With 600 lin.ft. of pipe line, a 90-ft. effective head can be developed and, based on minimum flow, the generation of 500 hp. per 8-hour day can be obtained.

This project was built by Col. A. E. Humphreys of Denver, Colo. The design and construction were carried out under the direction of Carl A. Gould of Denver. The contractor was Chapman & Pridmore, of Monte Vista, Colo. The construction work was carried to completion without a single serious accident.

Bypass Roads Should Not Be Hurriedly Adopted

Highway Departments Should Proceed Cautiously to Build Through Roads Around Cities Rather than Through Cities

By J. T. Donaghey
State Highway Engineer, Madison, Wis.

SHOULD a state highway department plan for constructing highways through or around cities?

Before attempting even to offer an opinion, it might be well to analyze the conditions, past and present, prevailing in practically all agricultural states.

The first road built in a community was for the purpose of permitting the early settler to reach the school, church, mill and market. This resulted in the direct roads from the future farms to market being the first to be laid out and built. As the farming community developed, these same roads were the first to be graded, drained and improved. Later on, when the automobile became a factor in traffic, these roads were also the first to be paved with a stone or gravel surface. Now, when traffic demands a higher type of surface, these same old roads are the ones first to receive attention.

Why should these roads be rebuilt of higher types decade after decade?

Because they are the real arteries of commerce in the community. They serve the farm to market travel, the inter-town traffic, the travel to school, to church and to the movies.

All the above mentioned travel is interested in and served by the road leading into and through the city. So also is the merchant, doctor and all others who dwell in the city which has been developed and primarily supported by agriculture. This is true with the majority of medium sized cities throughout the great Middle West.

Traffic counts taken by several states indicate that the farm to market, inter-town and other traffic wishing to enter the city on an average through highway, constitutes not less than 75 per cent of the travel between May 1 and Nov. 1, and will reach 90 per cent or more for the balance of the year. There are, of course, a few interstate highways in nearly every state that carry heavy through traffic, which, during a short period each year, help to congest traffic on certain city streets. While those in charge of traffic in such cities wish to avoid the congestion caused by through traffic, the city merchant, shop keeper and hotel man will never agree to routing the through travel around the city. He is conducting a legitimate business, primarily for personal gain and secondarily to serve the public. He has an investment, owns one or more motor vehicles, and helps to pay the cost of road construction and maintenance. He, therefore, believes, and justly so, that he is entitled to a chance at all business coming into or near the city.

City's Attitude Toward Bypass Roads—A state highway department should proceed very cautiously in planning to build through roads around cities rather than through them. Sufficient traffic counts should be taken to determine where traffic wishes to go.

Should such counts show that a large percentage of traffic is through traffic, then only should the department consider a bypass road, but in no case should such road be built around the city until after a road has been built serving the traffic that wishes to enter the city.

The time is coming, in fact, is here, when city officials and traffic officers will insist upon carrying the through traffic on streets other than the main business arteries.

I thoroughly agree with this idea, and believe that the problem has been partially solved in Wisconsin in a very satisfactory manner to all concerned. We have adopted a plan of duplicate marking. The through route is marked with the standard colors—black numbers on a white background—following less congested streets through the city and serves the purpose of a bypass road. The duplicate route follows the main street through the business section, and is marked with the same numbers in black on a yellow background. At the separation of the two routes, signs are placed showing the traveler that by following the white marking he avoids the congested city streets, and should he wish to pass through the business section he may follow the yellow markings, being assured it will lead him back to the through route.

Even with this reasonable method of providing a bypass road, we find it difficult at first to convince the city business man that he will lose little, if any, trade. Though in use but two seasons in a small way, the plan is rapidly gaining favor, and I am convinced we will have our most congested centers marked in this manner within a very short time.

I realize that conditions are entirely different in industrial sections and in many instances it is wise to build a bypass road rather than use the plan we are following.

From our experience in Wisconsin, I would advise first building the direct road into the city—the road that has from the beginning served the community, and helped in no small way to build up the wealth and increase the happiness of the whole state.

After this has been accomplished, if the duplicate marking fails to relieve the situation, build the bypass road around the city, but make those benefited pay.

Colorado-New Mexico Water Pact Approved

Congress on Jan. 29 approved a compact between Colorado and New Mexico concerning the use of the water of the La Plata River, a small stream near the western end of the interstate line, tributary to the San Juan, of the Colorado River system. The compact was formulated in 1922 by two commissioners, one from each of the states, and was ratified in the following year by the legislatures of Colorado and New Mexico. Its present approval by Congress puts the compact into effect. The compact provides for maintenance of two gaging stations on the river, one at the interstate boundary and one some distance to the north, which are to be continuously operated and are to furnish the means of controlling the division of water.

Early High Temperatures in Alumina Cement Concrete

Heat of Setting Raises Concrete Temperature Until High Strength Is Reached—Valuable For Cold Weather Work

A PRE-REQUISITE to the use of concrete in cold weather is that it should be kept above a temperature at which setting is retarded. In portland cement this is about 50 deg. F., and in cold weather concreting with portland cement precautions have to be taken by preheating the material and by protection of the concrete itself to insure that the temperature is maintained until the concrete has attained a set sufficient to carry construction loads. One of the advantages claimed for alumina cement is that it develops a greater temperature in setting than does portland and that concrete from it is subjected to this higher temperature during the relatively short setting period before the concrete reaches the high early strength it attains. In consequence alumina cement is recommended for cold weather concreting.

Tests supporting this contention have been submitted by the Atlas Lumnite Cement Co., which makes the only American alumina cement. Abstracted they are as follows:

Fig. 1 shows a series of standard compression tests made by the Pittsburgh Testing Laboratory on standard 1:3 mortar 2x4-in. cylinders. These results illustrate the rate of hardening of alumina cement under normal conditions.

Fig. 2 is a record of temperature readings of the air and an alumina cement concrete roadway slab taken by D. A. Soule, of the Rhode Island State Board of Public Roads, during the construction of a section of the Tiverton-Fall River Road. The temperatures of the concrete were taken by inserting a thermometer in a hole 4 in. deep in the surface of the concrete. They illustrate the rise in temperature of alumina cement concrete during the early period of hardening under average conditions.

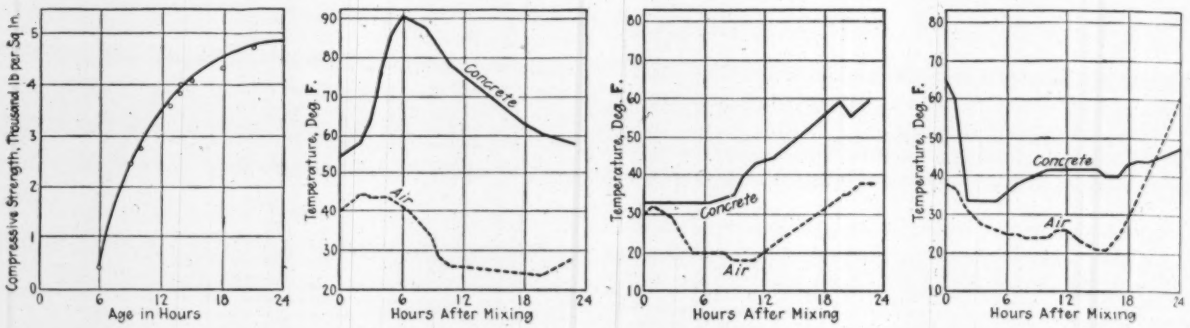
Figs. 3 and 4 are records of tests of alumina cement concrete from a road at North Wilbraham, Mass., built by E. F. Carlson & Co. under the supervision of the Massachusetts State Bureau of Highways. In Fig. 3 cold materials were used and the concrete placed in the forms without heating. The concrete was covered with a piece of canvas immediately after pouring.

The temperatures of the concrete were taken by placing a thermometer face down on the surface of a concrete curb inlet. This section of concrete was 7 in. thick at the top, approximately 10 in. thick at the bottom and 5 ft. long. This was a severe test because in addition to the use of cold materials the heat generated in such a small mass of concrete was rapidly dissipated as evidenced by no indication of a rise in temperature of the surface of the concrete during the first seven hours.

The temperatures recorded in Fig. 4 were taken during the hardening of an 8-in. road slab. Both the sand and gravel contained frozen lumps and, in order to thaw them out, a Hauck burner was used in the mixer. As a result, the temperature of the concrete when placed was 65 deg. F. The temperature of the concrete was taken by inserting a thermometer in a hole 4 in. deep in the surface of the concrete. The temperature of the surface of the concrete, taken by laying a thermometer face down on the concrete, averaged several degrees lower.

Recently some tests were made by Columbia University to determine the effect of low temperatures on the compressive strength of alumina cement concrete. Concrete cylinders, 6x11 in., were made of chilled materials and iced water in the proportions of one part alumina cement, two parts sand and four parts gravel. These cylinders were placed immediately in a freezer at about 25 deg. F. and kept there at that temperature until tested. The heat generated by the cement in hydrating was sufficient to keep the concrete from freezing until after it had hardened and developed considerable strength.

At the end of 24 hours some of the cylinders were removed from the freezer, plunged into hot water, and then tested in compression, developing a strength of over 2,300 lb. per square inch. At 28 days the rest of the cylinders were removed from the freezer, brought to room temperature, and tested in compression, developing a strength of approximately 3,300 lb. per square inch.



FIGS. 1-4—COMPRESSION AND TEMPERATURE TESTS ON ALUMINA CEMENT CONCRETE AND MORTAR

Fig. 1—Compression—2x4-in. 1:3 cylinders.
Fig. 2—Temperatures—Tiverton-Fall River Road.
Fig. 3—Temperatures—North Wilbraham Underpass.
Fig. 4—Temperatures—North Wilbraham Underpass.

New Ozone Plant Purifies Air in Central London Ry. Tube

Former Method of Drawing Impure Air from One End of Long Tunnel Is Discarded—Air Filtered and Ozonized

London Correspondence

UNTIL the recent extensions made a more positive system essential, the Central London Ry. had been ventilated on the exhaust system, the method consisting in closing all the doors underground for a certain period after the running of the last train, and in drawing air through the tube from one end to the other by means of a 200-hp. exhaust fan located at Shepherd's Bush. This thorough cleaning out every night was supplemented by a continuous running exhaust fan at the British Museum station, and the natural ventilating action of the running trains. In view, however, of the increasing traffic and the opening of the extensions in Ealing, a more positive system of ventilation was decided upon, and an elaborate equipment has been installed to provide during the whole of the day a large quantity of fresh air treated with ozone.

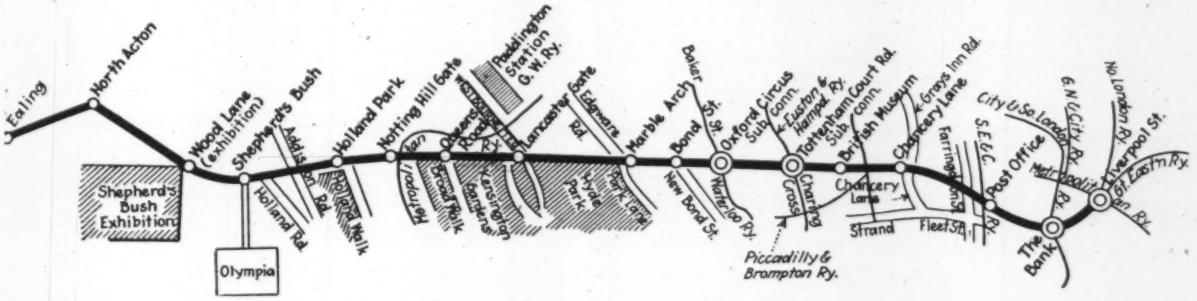


FIG. 1—ROUTE OF CENTRAL LONDON RAILWAY

The Central London Ry. cuts through the heart of London, from Ealing in the western suburbs to Liverpool St. in the city. The line is made up of two separate tunnels, aggregating about 20 miles, and interconnected at several points by crossovers, which, while convenient from a traffic point of view, have greatly increased the problem of ventilation. The tunnels follow the line of Uxbridge Road, Bayswater Road, Oxford St., Holborn and Cheapside, and are at a depth varying between 60 and 100 ft. below street surface, with seventeen stations. The trains consist of an average of seven cars, one or two of which in each train are equipped with electric motors, receiving current from the third rail. It is estimated that there are about 12,000 people in the tunnels continuously for three or four hours.

In the ozone system of ventilation now installed the air supply is drawn from as clean a source as possible and filtered to remove sulphurous gases, smuts and solid matter. The cleaned air is then passed into a mixing chamber where it is mixed with a small amount of ozone, whence it is distributed through ducts to the various parts of the tunnels. The equipment consists in an independent plant at each station, with the exception of Shepherd's Bush, which is near the open end of the tunnel.

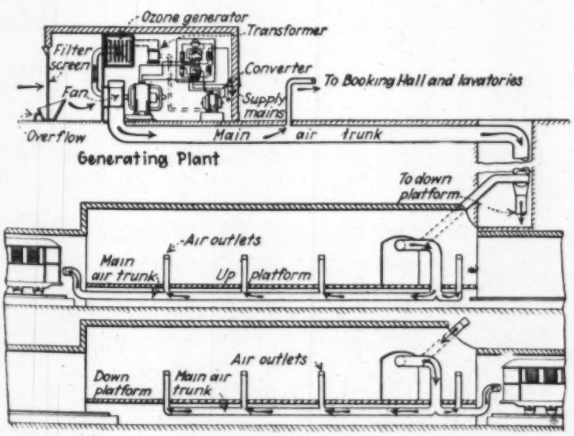


FIG. 2—GENERAL ARRANGEMENT OF VENTILATING EQUIPMENT FOR CENTRAL LONDON RAILWAY

The ozone generator consists of a series of ten generating units, each comprising a thin mica plate with a sheet of metallic gauze on either side, the set of ten plates being spaced and mounted on insulating supports. The gauze sheets are connected across the secondary of a small transformer delivering alternating current at a pressure of several thousand volts, with the result that an innumerable number of minute discharges occur all over the opposing faces of these plates.

The ozonized air thus generated is conveyed to the mixing chamber of the main ventilating fan where it is mixed with the main current of air, and thence blown into the main air trunk to the various sheet metal ducts. Most of the units each pass normally some 360,000 cu.ft. of air per hour. The proportion of ozone and the volume of air supplied can be regulated from the switchboards controlling each plant.

The main fans are operated by 7½-hp. motors. The ozone generator is supplied with current at 5,000 v. from a transformer fed at 380 v. a.c. from a small 550-v. rotary converter. Many difficulties had to be overcome in the design of these rotary converters before they could be built to work satisfactorily on account of their small size and high direct-current voltage. The units provided with 7½-hp. motors deliver from 5,500 to 6,500 cu.ft. of air per minute, but the plants at Holland Park and British Museum deliver 18,000 and 10,000 cu.ft. of air per minute, respectively.

Substructure Plan and Design: Buffalo Filter Plant

Layout and Design Problems and Operating Plan Described—Present Capacity 160,000,000 Gal.—Future Extension to 400,000,000 Gal. Capacity Is Planned

CONSTRUCTION has reached an advanced stage on the 160-m.g.d. water filtration plant for Buffalo, N. Y. This is the first unit of an ultimate 400-m.g.d. installation and calls for the immediate expenditure of about $4,000,000. Both the planning and the construction problems are of interest. The thought is that the partial installation, allowing a 50 per cent overload on the filters for a short period daily, will meet the demands for a number of years. Then the additional filters can be put in. Meanwhile, the low pressure pumping station and the conduits, which will also serve the extended plant, will be built for a 400-m.g.d. service.

Buffalo takes its water from the Niagara River through an intake tunnel 6,300 ft. long and 12x11¼ ft. inside the concrete lining. Shore conduits, as indicated by Fig. 1, carry the water to the Francis G. Ward and the Massachusetts Avenue pumping stations, both on the river shore and about 4,000 ft. apart. The stations have a combined capacity of 330 m.g.d. and the Ward station has space for three more 40-m.g.d. pumps. With certain conduit changes indicated by Fig. 1, the two stations have ample capacity for the filter plant. The Ward station will be the larger and the main distributing unit.

Layout Problem—As shown by Fig. 1, the immediate installation consists of a low-lift pumping plant, raw and clear water conduits, the filtered water reservoir and filters and the coagulation basin. In arranging these units the determining considerations were: (1) Economic position with respect to the Ward station and the intake conduits and (2) need of having the filtered water reach the pumps of both stations at approximately lake level, El. 572.8. The situation was fortunate for these requirements.

South of the Ward station there was a city-owned tract of about 30 acres enclosed by a concrete dock wall and under water for about half its area. The topography is given by Fig. 2. An area about 600x700 ft. (Fig. 1) being required for the filter structures, it will be noted that it was possible by placing the coagulation basin and the filters east and west, with the clear water channel between, to utilize the material from the sedimentation basin excavation for fill behind the dock wall and get a protecting embankment 120 to

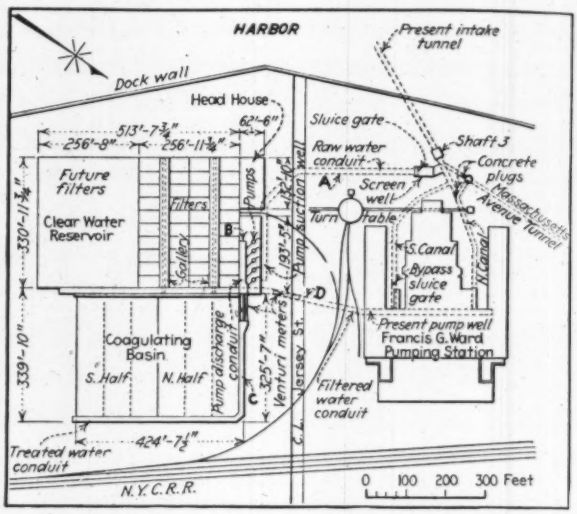


FIG. 1—LOCATION AND OPERATING PLAN DIAGRAM

250 ft. wide between the work and the river. This structure arrangement also met the location and pumping head requirements, and it put the coagulation basin on the higher ground so that proper head on the filters was easier to obtain.

Operating Plan—In particular the arrangement of structures and their location with respect to the intake conduits and the Ward pumping station gave a straightforward operating plan. It is best followed through

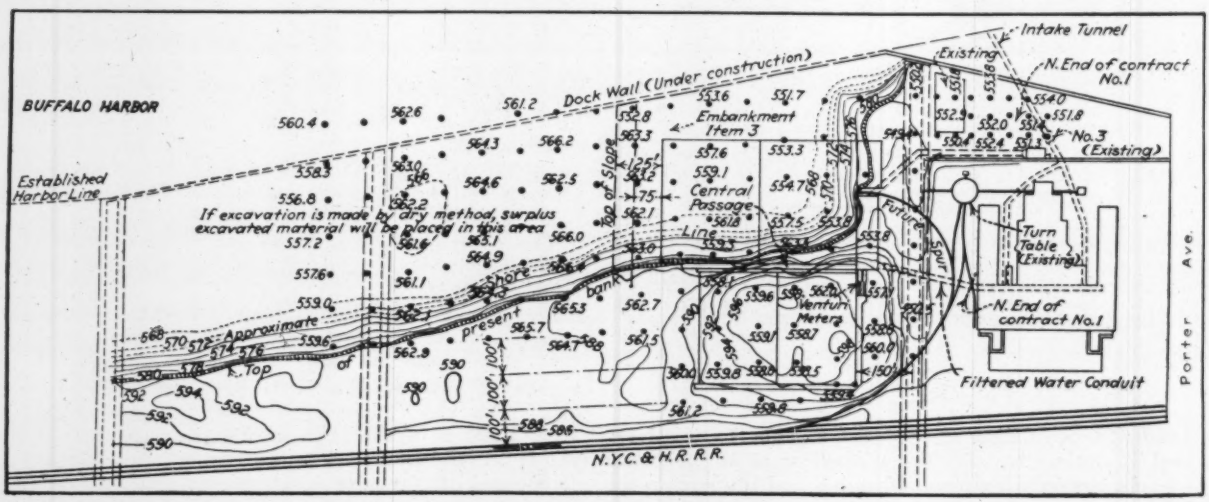


FIG. 2—CONTOUR AND BORE HOLE MAP OF LOCATION

on Fig. 1, with Figs. 3 and 4 indicating respectively the filter plant and sedimentation basin structures.

Raw water is taken from the intake at lake level, through conduit *A* to the low-lift pump well. Fig. 1

FIG. 3—TOP VIEW OF FILTER PLANT STRUCTURE

shows how the present shore intake tunnels are plugged to make this interception possible. Electrically operated pumps lift the raw water into conduit *B* at El. 587, which is high water in the coagulating basin. From *B* the flow is through two 48-in. Venturi meters into the treated water conduit *C* from the east arm of which the water is discharged over a weir into the coagulating basin. With the even distribution by weir, the baffle and training walls indicated by Fig. 4 are expected to complete mixing and prevent cross-currents. The coagulant is fed into the raw water conduit *A* behind the pumps. In view of the low turbidity, 0 to 250 p.p.m., it was considered that the centrifugal pumps would provide sufficient mixing and the usual separate mixing chamber could be saved.

From the coagulating basin the water passes over a skimming weir along the west side and is collected into conduits down the centers of the galleries and from them enters the filter tanks over the clear water reservoir. This is an 18-m.g. basin of five separate chambers and from it eight 4-ft.-square sluices deliver the water to the filtered water conduit *D* which delivers to the Ward station pump well at practically lake level.

Structure Details—In tracing the water flow, general details of structure were omitted which deserve attention. It has been mentioned that the treated water conduit has two Venturi meters. There is another with a 72-in. throat in the clear water circuit. All are concrete, the section being circular for the two handling treated water and square for the one handling clear water. The smaller meters have 72-in. discharge ends and the larger an end section 12 x 12 ft. With recording gages, these meters give the indications by which the application of coagulant and chlorine are controlled. Another detail of structure in connection with water flow is the multiple discharge gates, as the eight gates from the clear water reservoir to the clear water conduit, which prevent stagnation of movement in any place.

The filters (Fig. 1) consist of forty 4-m.g. units placed in four rows of ten filters each. The filters discharge through Venturi type controllers into the clear water reservoir. Fig. 3 indicates the filter structure Except as a design and construction problem neither the coagulation basin nor the filters call for further description as structures. This is also true of the raw and filtered water conduits, which are both heavily reinforced concrete rectangular shells founded on rock. Fig. 5 gives a typical section of the filtered water conduit, but shows especially the general details of the large Venturi meter in this conduit.

Design Problems—Ground surface and underlying rock elevations (Fig. 2) were worked out to advantage in developing the general design. As stated, the lake level is at El. 572.8. Over the whole site the average rock level is at El. 554. Ground level is about El. 587. With 160-m.g.d. filter capacity and a 3-hour sedimentation period (this was considered long enough) a 20-m.g. coagulating basin was large enough. Covered basins—both coagulating and clear water—were demanded by the Buffalo climate to prevent freezing. Also the necessity of periodically draining the coagulating basin required under-floor drains. With rock so near the surface no other foundation could reasonably be considered.

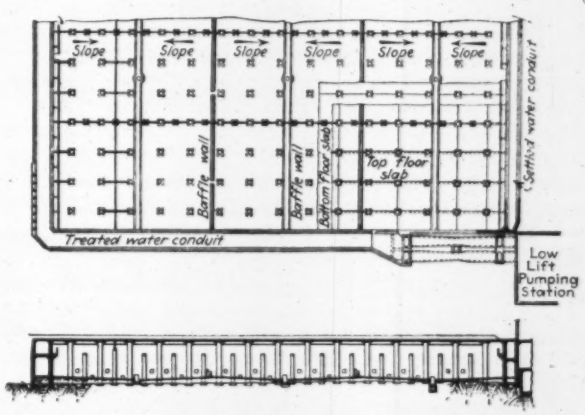


FIG. 4—PART PLAN AND SECTION, COAGULATING BASIN

Under the conditions a clear water reservoir with its floor on rock and having the filters superimposed gave the economical arrangement. This also worked out well in conjunction with a coagulating unit located on land and east of the filters. With its top at about ground surface, El. 587, enough head was had for filter operation, and the walls could go to rock foundation without difficulty. Finally an inside floor could be built on the soil at an elevation above rock which left plenty of room underneath for drains.

Being built below water level the walls had to be designed for hydrostatic pressure on either side. They are designed as slabs supported at both edges against pressure either outward or inward. This calls for reinforcement in both faces. It also calls for virtually monolithic structure. There is not an expansion joint in either basin or reservoir; the only joint is between the two. Incidentally, the finished coagulating basin has gone through a summer and a winter without showing cracks. Top and bottom edge support of the sidewalk slabs is got in two ways:

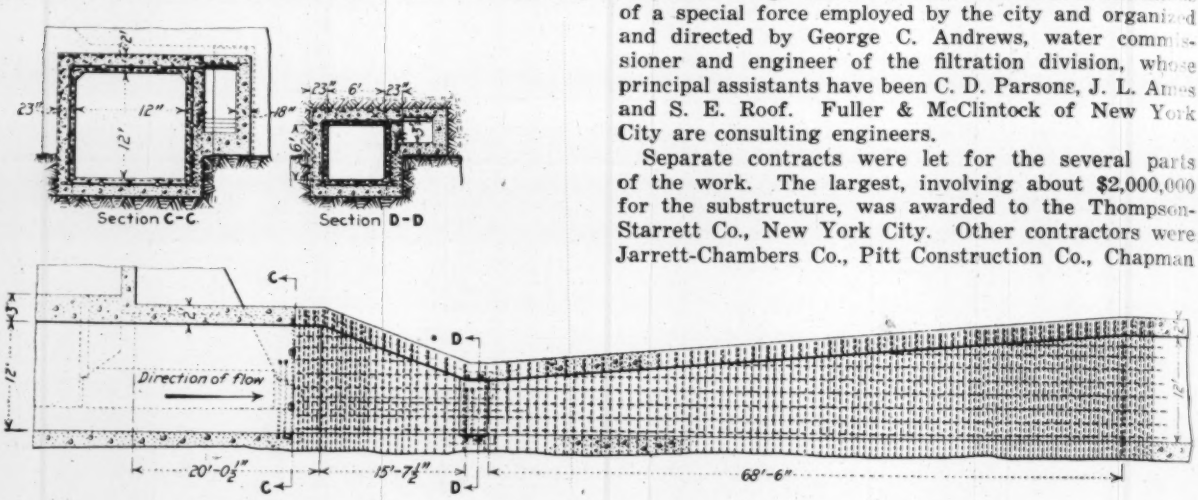


FIG. 5—DETAILS OF VENTURI METER FOR CLEAR WATER CONDUIT

In case of the coagulating basin the top edge reactions are carried by the roof and the bottom edge reactions by doweling the wall footings into the rock (Fig. 4). The roof is flat-slab construction on columns spaced 20 ft. each way. This roof is designed for 100-lb. live-load and 250-lb. earth cover per square foot. In addition to the tension steel which takes care of this vertical loading, there is in the slab a reaction network, rods in both directions, reaching entirely across from wall to wall. It was felt that while probably at no time would there ever be a condition of maximum loading over the entire roof area, yet the omission of expansion joints warranted excess steel. In the clear water reservoir, the roof is the beam-and-slab floor on columns spaced 16 x 16 ft., which carries the filters. The tanks filled and with 30 in. of gravel give a load of about 900 lb. a square foot. The floor slab was made 13 in. thick.

In the clear water reservoir the floor is concrete laid directly on the rock, a flint and limestone formation in vertical layers of 6 in. to 2 ft. These layers step down toward the northwest and where lowest carry considerable water. Here underdrains were put in, as will be described in the succeeding article on construction methods. In the coagulating basin the floor, as shown, is laid within the walls on the clay fill overlying the rock. It serves no purpose in bracing the walls. The construction details are given in Fig. 4.

Materials—About 54,000 cu.yd. of concrete and 4,000 tons of reinforcing steel were required for the concrete structures. All concrete was one part cement and five parts natural-mix Niagara sand and gravel. This natural mixture was found by tests to make more dense and watertight concrete than could be got by screening and reproportioning.

Engineers and Contractors—All engineering with respect to design and construction has been in the hands of a special force employed by the city and organized and directed by George C. Andrews, water commissioner and engineer of the filtration division, whose principal assistants have been C. D. Parsons, J. L. Ames and S. E. Roof. Fuller & McClintock of New York City are consulting engineers.

Separate contracts were let for the several parts of the work. The largest, involving about $2,000,000 for the substructure, was awarded to the Thompson-Starrett Co., New York City. Other contractors were Jarrett-Chambers Co., Pitt Construction Co., Chapman Valve Co., Michigan Valve Co., Rensselaer Valve Co., U. S. Cast Iron Pipe Co., Bowler Foundry Co., McWane Cast Iron Pipe Co., and the Dayton-Dowd Co.

[*Construction plant and methods will be illustrated and described in a succeeding article planned for early publication.*—EDITOR.]

Auxiliary Railway Transportation in South Africa

TO MEET the demands for railway communication in thinly settled districts, the South African Government Railways are introducing rail-motor cars on branches and pioneer lines and the Dutton road-rail system. For this latter, in which a tractor traveling on the road or roadbed hauls cars traveling on a light track, a 20½-mile line between Naboomspruit and Singlewood was put in service in September, 1924. Locally built rail-motors have been operated on three or four lines, but were of insufficient capacity for week-end traffic so that they have been confined in general to weekday service. As a result, two British machines have been put in service, each carrying 400 passengers; one is operated by steam and the other by an internal-combustion engine.

Experiments with a car operated by a 120-hp. producer-gas engine with electrical transmission were so satisfactory that a 500-hp. machine was ordered. The first machine hauls a regular passenger car. Seven road-motor services are operated by the railway administration, and there are continual demands for similar services in various rural districts, but the 1924 report of Sir. W. W. Hoy, general manager of railways and harbors, states that "The success of motor transport depends to a very great extent upon the existence of good roads, and unfortunately South Africa is seriously handicapped in this respect."

Excess Typhoid Attributed to Shell Oysters from One Source

Outbreak at New York, Chicago and Washington Charged by U. S. P. H. S. to Contamination Between Oct. 25 and Dec. 20

Preliminary Report of United States Public Health Service, dated Feb. 9, given in full.

OBSERVATIONS of the situations in Chicago and New York were made by our officers from the first appearance of evidence of an excessive prevalence of typhoid fever in those cities in December. Intensive studies by our officers were begun in New York City and vicinity on Jan. 5, in Chicago and vicinity and in the District of Columbia on Jan. 12, and in the several other cities on or about Jan. 23, 1925.

These studies have included (1) a searching inquiry, made for the large majority by direct interview with the person affected, into conditions such as food and beverages, etc., to which the persons affected had been exposed within the thirty days immediately preceding illness for 98 cases in Chicago and vicinity, 42 cases in Washington, and 263 cases in New York City; and (2) a thorough investigation of every factor, including water, milk, milk products, vegetables, fruits, shellfish, local sanitary conditions, etc., which might possibly have been operative in the spread of the infection.

Within the period Nov. 15 to Jan. 15, the excess of cases of typhoid fever reported in New York City was about 650; in Chicago, about 100; and in Washington, about 50. The number of cases investigated individually by us in each of these cities was sufficient to give us a clear epidemiological picture of the whole situation.

The chronology of the outbreaks suggested a common factor in the distribution of the infection in all three cities. The epidemiological histories of the individual cases obtained by the respective city health departments of all the cases checked substantially with those obtained by us in our intensive and usually direct inquiry among individual cases. The co-operation received by us from the city and state health officials concerned has been excellent, without exception, throughout the course of these studies.

Conclusions—A full report setting forth in detail all the evidence will be submitted as soon as practicable; but, as the preparation of such report will require several weeks, the following definite conclusions are submitted at this time:

1. The main factor in the spread of the infection causing the recent excessive prevalence of typhoid fever in New York City, Chicago, Washington, D. C., and several other cities in the United States, was, beyond reasonable doubt, shell oysters distributed by a producing company operating within the vicinity of West Sayville, New York.

2. The preponderance of evidence is that the general supply of no large distributor of oysters was uniformly infected, but that oysters infected in one or more beds or part or parts of one or more beds or at one or more floats, and constituting but a small proportion of the total, were introduced into and distributed with a large supply of oysters of good sanitary quality.

3. The period of causation of the excessive prevalence was between Oct. 25 and Dec. 20, 1924, and there is no reason to believe that oysters distributed since Dec. 20 by the company referred to in Conclusion 1, or any other large distributor, have been any more of a factor in the spread of typhoid infection than such oysters were in any corresponding period within the last several years.

4. The evidence is that due to temperature changes in some bed or beds or part or parts thereof, to discontinuance of receipts from the infected source or sources; or to sanitary measures which have been carried out by the oyster producers within the vicinity of their floats and on their dredging boats, or to a combination of such factors of safety, oysters on the market since Dec. 20, 1924, have been free from any considerable degree of typhoid infection and that those now being sold or offered for sale are, from a sanitary standpoint, as safe to eat as raw food as is usual at this season of the year.

5. There is no evidence that shellfish other than oysters or that scale fish contributed to the spread of the infection causing the recent excessive prevalence of typhoid fever, and there is no reasonable cause for any popular apprehension that shellfish or scale fish which are heated throughout to a temperature of 100 deg. C. before being eaten are not now as safe and salutary for human consumption as usual.

6. In the interests both of our public health and of our food industries, provision should be made at the earliest possible date (certainly before March 4, 1925) for more nearly adequate official sanitary supervision, regulation, and protection of industries engaged in the production, preparation for sale, and distribution in interstate traffic, of shellfish, vegetables, fruits, milk, milk products, and other foods eaten usually or frequently without being cooked.

This important investigation has been made under the direction of Dr. L. L. Lumsden, assisted by many other trained officers and sanitary engineers of the Public Health Service. In view of the fact that reports of the outbreaks of typhoid fever throughout the country among the classes who are accustomed to eat oysters resulted in a practical cessation of not only the oyster industry but seriously affected the traffic in other fish products, this preliminary report is issued before the completion of the final report.

New York Legislative Committee Report on Recent Excess Typhoid

A WEEK before the date of the Public Health Service report on the recent excess of typhoid fever in several cities, printed in full above, a New York Legislative Committee on the Pollution of Tidal and Inland Waters, of which Senator John J. Dunnigan is chairman, submitted a preliminary report dealing with the possibility of oysters from polluted New York waters being the cause of the excess typhoid in question. The committee found "no direct evidence that infected shellfish, particularly oysters, were the major factor in the production of the recent increase in typhoid fever in New York City, and elsewhere." (See tables below.) The report says, in effect, that the evidence in the case shows that when the consumption of oysters practically ceased typhoid fell to a relatively low figure. The report describes as mysterious the fact that although no contamination was found of oysters or water above them subject to swift tidal currents there was bacterial evidence of contamination of the same oysters later on, reported by the New York Health Department. The report also reports evidence of lack of good sanitation on oyster boats and at oyster floating or freshening places and cites the possibility of oyster bootlegging.

NEW YORK CITY TYPHOID, NOV. 1, 1924, TO JAN. 31, 1925

Week Ending	Cases Reported	Deaths Reported
Nov. 8	10	1
15	21	2
22	32	1
29	72	6
Dec. 6	127	9
13	109	16
20	168	24
27	96	15
Jan. 3	99	17
10	66	18
17	34	11
24	25	4
31	26	6
Totals	885	130
Same period, 1923-4	177	30
Excess, 1924-5	708	100

TYPHOID FEVER FATALITIES IN NEW YORK, 1919-1924

Year	Cases	Deaths	Case Fatality, Per Cent	Death Rate per 100,000
1919	854	121	14.2	2
1920	969	137	14.1	2
1921	899	123	13.7	2
1922	790	129	16.3	2
1923	890	140	15.7	2
1924	1,687	184*	10.9*	2*

[*In considering deaths, fatality and death rate for 1924 it should be remembered that the heavy excess of typhoid for the year came chiefly in December and reached its height late in the month; see weekly figures above for both December and January. —EDITOR.]

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Technical Book from the Soviet Press

REVIEWED BY LEON S. MOISSEIFF
Consulting Engineer, One Liberty St, New York City

STROETELNAYA MECHANIKA; TCHAST PERVAYA: SOPROTEVLENEE MATEREALOV (MECHANICS OF STRUCTURES; First Part: The Strength of Materials)—By Engineer Professor John Podolsky. Moscow, Russia: Gosoodarstvennoe Technitcheskoe dazelstvo. Paper; 7x11 in.; pp. 1,035; 672 line drawings.

In 1906 the present writer had the pleasure to review in these pages Professor Podolsky's book on Reinforced Concrete Bridges and Viaducts and again in 1909 his book on Trusses Without Diagonals. Since then much time has elapsed and fundamental changes have taken place in the political and social life of Russia. It is, therefore, with a keen interest that Professor Podolsky's large book on the Strength of Materials is taken up. It is the first technical book published by the Soviet government that has come into the writer's hands, though the book's covers list over a hundred books on various technical subjects published or in print. The book carries on its title page the Marxian heading: "Proletarians of all lands unite." Human institutions may vary widely through the ages but the human mind remains forever narrow. The mechanical sciences are, however, unaffected by changes in governments and laws made by man and the theory of the resistance of materials follows its natural evolution. Professor Podolsky's work is an excellent illustration to this effect.

The book shows a marked tendency to be clear and easily digestible. This is evidently a result of the social changes which have taken place in Russia. Admission to the universities and higher technical schools has been made easier by lowering the preparatory requirements. As a consequence the number of students has increased very much but their mental baggage is light. There is felt therefore the necessity to teach so that the students can easily follow. A similar tendency can be seen in the Russian belles-lettres of recent times, a tendency to approach the subject directly and frankly. The author of the book now in hand makes free use of differential and integral calculus but he gives the full deduction of the equations so that one with elementary knowledge of the subject can readily follow step by step. He is clear and simple in his explanations and he comments freely on the limitations of the case. The book is based on the course on the resistance of materials given at the Moscow Academy of the Aerial Fleet.

The work is modern in its conceptions and the author is familiar with the latest observations on the behavior of materials. It is, however, largely theoretical inasmuch as such tables as are given on the strength of materials are informative only. Direct results of tests are not given.

The phenomena of tension and compression are given 140 pp., in which the behavior of metals before and after passing the elastic limit is thoroughly discussed. Half as many pages are taken up by shear and torsion. Much space is devoted to bending. Shearing stresses in beams are clearly treated. The well known formulas for beams under various conditions of restraint are deduced frequently by several methods so as to illustrate the greater fitness of application of the one or the other. About 150 pp. treat of the work of elastic forces. The work of deformation and the main theorems on the work of elastic deformation are fully discussed.

As a whole the author presents an up-to-date textbook on the theory of resistance of materials and it is gratifying to see good work produced in Russia in its times of labor. Five thousand copies have been struck off in the printery of the Red Agitator.

Riding a Malthusian Nightmare

POPULATION AND THE SOCIAL PROBLEM: By J. Swinburne, F.R.S. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 380. $5.

Internal evidence and a reference to the British Who's Who warrant the assumption that the author of this brilliantly written but pessimistic book is a retired or semi-retired mechanical engineer who stables two hobbies, rides one until wearied and then gets relief by changing to the other. The first hobby is the Malthusian nightmare, black and awful, yclept Population Pressure; the second is a lively bay, Music. As the latter is kept in the background of the book before us it needs no further mention.

Of the two elements of the title of the book, Population receives far less consideration than Social Reform, the latter being reviewed at length with intent of showing the futility of all efforts to alleviate poverty and its evils that are not based on an attempt to control population pressure by the limitation of families. The discussion of population is scattered through a succession of chapters on causes of ignorance, on wealth and its distribution, capital and labor, profit sharing, trade unions, war, government, women, doles and socialism. The discussion on population pressure is theoretical and mathematical. The argument holds no promise of complete or lasting relief, if the author's reasoning is correct, until the whole world is brought to practice what the author preaches, since until population is limited everywhere the pressure it exerts in vast areas still in ignorance of Neomalthusianism will soon flood out all the gain in the relatively small areas of restriction which alone may be expected for some centuries to come.

The mathematics of the book are easy to follow. They and the occasional illustrations drawn from physics and mechanics will appeal to the engineer and not be lost on the intelligent general reader.

The volume has the faults and advantages of all books that ably set up a single cure for an ill and deny virtue in all other remedies. If less tolerant than some other propagandists, Mr. Swinburne is more brilliant and thought provoking, while he makes it plain, perhaps

plainer than he realizes, that his particular recipe for the millenium will require perhaps a million years for its working out.

With the hope of leading many to read a book that is worth while for its style and some of its reasoning even if it arouse more dissent than assent, some of an abundance of quotable passages are appended, the figures in parentheses being page numbers:

Most of us dislike brain work any more intense than that necessary for amusement. The result is that broadly speaking, we are all fools except in one narrow line . . . of professional or bread-winning work . . . We deal with all the other matters with the fallow mind. (31)

The economic man is a convenient abstraction invented for the simplification of discussion; he is akin to the frictionless machinery which helps one to arrive at the truth in mechanics. (35)

On mechanical questions the general public, *politicians apart* [italics ours], are willing to be guided by engineers. . . . The ordinary man . . . thinks that if an economic matter is a little out of his depth it can be settled at once by practical business men; just as a mechanical problem might be solved by engineers. . . . The result is that economics has no influence on public opinion. (46)

Our governments are run by untrained men elected by people who have given no thought to the matter, and guided by party spirit and newspaper articles. (51) . . . the government in all countries is as bad as its people will stand. (203)

Economics differs from such sciences as chemistry and physics in being a study of tendencies. There is no exact measurement. It may be said that what has no exact measurement is not a science. (231)

No way of electing a committee or council of a scientific or technical society has been devised, such that the best men are chosen by the body of the members. (247)

. . . government in a democracy . . . is really an organization working in its own interest. It is practically self-appointed and self-appointing, and the voters, as such, have no real control over it. (249) . . . Democracy itself has a strong tendency towards anarchy. It teaches that the opinion of a fool is as important as the conclusion of a wise man . . . (251) . . . women are not engineers . . . women cannot invent or design, make or control complicated and elaborate machinery because their brains are not like men's. It is not a matter of training, because many inventors and many engineers have had no special training. . . . Women have been employed as tracers for at least forty-five years, but they get no further. (263)

Liberty, Property and the State

LEGAL FOUNDATIONS OF CAPITALISM—By John R. Commons, Professor of Economics in the University of Wisconsin. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 394. $3.

When it is stated that the author expects to follow this book with one "leading up to practical applications of a theory of Reasonable Value to Current Problems" and that much of the present volume is devoted to the very foundations of state control of public utilities, its possible interest to many engineers is apparent. Not that the book is confined to utility problems. Far from it. It conforms to its title, The Legal Foundations of Capitalism. The presentation of the subject is so broad as to include a review of the evolution of English and American law as related to liberty and property, but from the individual and collective or sovereign state viewpoints, from William the Conqueror and Magna Charta down through the leading law cases in England and the United States, including the successive ruling decisions of our own Supreme Court. Kings, barons, freemen, guilds, the church, corporations, labor unions, legislatures, courts and the police, all are taken into account.

Some idea of the mode of treatment may be gained from a few of the main heads and sub-heads: Property, Liberty and Value; Physical, Economic and Moral Power; Going Concerns, in which chapter are reviewed many leading court decisions on which rest the present legal theory of utility regulation; The Rent Bargain, under which capitalism and exchange value enter; The Wage Bargain, or industrialism; and Public Purposes. The last-named chapter has two significant sections dealing with the Working Rules of Going Concerns and Due Process of Thinking, in the course of which it is shown how the "due process of law" has changed from concern over procedure to concern over purpose, after which attention is given to precedents and the need of "discretion in thinking" in order to determine the weight that should be given to precedents.

The author shows a remarkable grasp of underlying principles and of historic facts, largely court decisions. These are passed and repassed in reviews in order to show the profound changes in the conceptions of liberty and property and the control of both by the state in the eight centuries that have elapsed since all property and all power were held to be vested in William the Conqueror.

A Short Lift of William T. Sedgwick

A PIONEER OF PUBLIC HEALTH: WILLIAM THOMPSON SEDGWICK—By E. O. Jordan, G. C. Whipple, C.-E. A. Winslow. With an Introduction by Mary K. Sedgwick. New Haven, Conn.: Yale University Press. London: Humphrey Milford, Oxford University Press. Cloth; 6x9 in.; pp. 193; 3 halftones. $2.

Hundreds of students of the late Professor Sedgwick at the Massachusetts Institute of Technology and other hundreds who came under the influence of his spoken or written word will welcome this brief but sufficient sketch of his life, work and personality. After an Introduction there is a brief review of the public health movement in the seventies. This is followed by a sketch of Sedgwick's school and college training, in the high school of Hartford, Conn., at Yale and at Johns Hopkins. The next two sections deal with the Department of Biology and Public Health at Massachusetts Institute of Technology and the contribution of the Institute to the public health movement in America. Other chapters treat of Sedgwick as a teacher and in public service in various civic capacities. The final chapter, As a Man Thinketh, deals with Sedgwick as a man. Of two appendices, one contains a chronological list of Sedgwick's published writings and the other gives a partial list of graduates and former students in the M. I. T. Department of Biology and Public Health during Sedgwick's incumbency. Several portraits add to the interest and value of the book.

Useful for Contractors

MANUAL OF THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA: 1924 ISSUE. Washington, D. C.: Associated General Contractors of America. Cloth (expansion or loose-leaf binder); 9 x 12 in.; 24 sections consisting of pamphlets or forms. $0.50.

A collection of the standard documents and data formulated and compiled by the Associated General Contractors makes up this volume. There are 28 separate titles, including standard contracts, building estimate and job overhead summaries, estimating grading and paving costs, computing equipment rental, uniform overhaul computations and advantages of winter construction. Most of these documents have been previously issued from time to time and are known to contractors.

For the present volume they have been revised to include all changes and represent each on its subject the latest conclusions of the association committees working with the experience of in some cases several years' use of the original forms. Contractors will find this a useful volume to have by them.

Railroad Freight Transportation

PRINCIPLES OF RAILWAY TRANSPORTATION: By Eliot Jones, Ph.D., Professor of Economics in Stanford University; author of "The Trust Problem in the United States," "The Anthracite Coal Combination in the United States." New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 607. $3.50.

The engineer is the master toolmaker. His business it is to provide and maintain all those complicated agencies through which man wrests a living from his environment. We are too prone to think of his products as mere inert structures, as a dam, a highway or a building. Especially is this true of the civil engineer so much of whose work is in terms of fixed structures. It is hard to think of his achievements in dynamic terms and yet they all are tools forged for the use of industry, of commerce or of the community.

Because of this it is helpful for the engineer to read a book such as Professor Jones'. He tells of railways, not as a succession of cuts and fills, bridges and culverts, ties and rails, but rather as a transportation machine, a tool of modern commerce. "This volume," he says in his Preface, "discusses the railway business primarily from the standpoint of the consumer of railway freight service," in other words from the viewpoint of the user of the tool. It always is worth while for the toolmaker to hear his work discussed from that viewpoint. So engineers in general, and railway engineers in particular, will find much to interest them here. Some of the matter on theory of rates they may pass up, but the chapters on organization and operation they will want to read. So too with those on railway accounting and geography and with Part V, which deals with the procedure of handling freight through the traffic department.

Altogether the book is a handy and concise survey of its subject, "The Business of Railway Transportation," with the addition perhaps of a qualifying adjective to limit it to the freight end of the business.

Our Enemy the Rat

RATS, AND HOW TO DESTROY THEM: Dealing with Rats in a House, Shop, Warehouse, Yard, Garden, by a River, on a Ship, or Farm, and in Sewers, etc.—By Mark Hovell, F. R. C. S.; With Introduction by S. L. Bensusan. London: John Bale, Sons & Danielsson, Ltd. Cloth; 6x9 in.; pp. 465; line drawings. 11s. 6d. in London, post free; $4 from G. E. Stechert & Co., New York City.

The Mongoose should not be used in rat control work nor should rat campaigns on estates or other private premises be held up so the boys may have some fun in "ratting" when home from school on vacations. When one reaches into a tub for a ferret the movement of the hand should not be violent or the ferret may bite. Rat exterminators who get to close quarters with rats should bear in mind the fact that in lieu of other refuge a rat may rush up a trousers leg. When fresh straw is put in the kennel the dog should be unchained and allowed to enter the kennel and make his bed to his own liking; if not unchained he will tangle the straw in his chain and make a muss generally. Among steel traps the one favored by the author is like the old time trap American boys use or did use a half century ago for woodchucks. In setting these or any trap for rats the human hand should never touch the trap. Every trap in a series should be provided with signal to show whether or not it has been sprung and traps should be kept oiled.

The foregoing are but a few of the many and wide ranging admonitions given in this comprehensive and practical book on keeping down the rat population, which, because not kept down causes millions of pounds of waste and damage in Great Britain, the author forcibly states, besides being a menace to health in a variety of ways set forth in the book.

Since the number of engineers and inspectors engaged in rat control work for public authorities and private individuals and concerns the world over is great, and as yet only a small percentage of what protection to health and property demands, the book should have a wide field of usefulness.

Fifty Years of American Portland Cement

HISTORY OF THE PORTLAND CEMENT INDUSTRY IN THE UNITED STATES: With Appendices Covering Progress of the Industry by Years and an Outline of the Organization and Activities of the Portland Cement Association—Written by Robert W. Lesley, First President, Portland Cement Association, Past Vice-President, American Society for Testing Materials, etc., etc.; In co-operation with his Fellow Members of the Committee on History: the Late John B. Lober, Second President, Portland Cement Association, President, Vulcanite Portland Cement Co., Philadelphia; and George S. Bartlett, Universal Portland Cement Co., Chicago. Chicago: International Trade Press, Inc. Cloth; 6x9 in.; pp. 330; halftones and line cuts. $3.

Any industry that can grow in fifty years from nothing to a gross annual business of nearly a half-billion of dollars deserves to have its history written. The cement industry is particularly fortunate in having a man like Mr. Lesley who, still in the full vigor of mind and memory, can look back over a half-century of activity in this wonderful development of which, in the words of Aeneas, a great part he was. For it was in 1874 that he, in company with John W. Trinkle, both advertising clerks on a Philadelphia newspaper, started to sell some few barrels of a new product, portland cement, that had been dumped upon them by a physician uncle of young Lesley, who had a struggling cement mill on his hands. From that day to this Robert Lesley has been in the heart of the cement business, as salesman, manufacturer and mentor. It is peculiarly fitting that he should write its history.

That history is an absorbing study of commercial beginnings. It tells how a few scattered pioneers, experienced sometimes in the older natural cements, interested more often in the stories of the new artificial cements which came from Europe, began hesitatingly to experiment with the production of this material in the United States. Not only had they to overcome the natural difficulties of manufacture, but they had also to combat on the one side ignorance as to what portland cement really was and on the other the competition from the European portlands that had already been accepted by the informed few.

Slowly they made headway; 82,000 bbl. in the whole decade from 1870 to 1879, 100,000 bbl. in 1884, not reaching the million mark until 1896—and then the upward shoot of the curve to the grand total of nearly 150,000,000 bbl. in 1924. Truly a remarkable story of achievement. Mr. Lesley tells of the struggles of these pioneers in precise terms, giving names and places. He traces the technical development, the growth of the specification, the bettering of manufacturing practice

—all in detail terms. And he concludes with a record of the performance of the Portland Cement Association, a record, to be sure, of interest only to the manufacturing end of the industry, but worth setting down.

Too infrequently are records such as this one made. Engineers, particularly, are too apt to take the past as a matter of course and to consider it of no importance in present affairs. In the field of cement, however, they have now no excuse in neglecting that which has been done, for it is here set before them. There are changes ahead in the cement business, changes that should interest the engineer user of cement. If he is to participate properly in formulating these changes, he should know how the present cement came to be, industrially as well as technically, so that he may better understand how present policies developed. For his aid in this education, no better course could be suggested than a perusal of Mr. Lesley's book.

PUBLICATIONS RECEIVED

OF UNUSUAL INTEREST TO SANITARY ENGINEERS is the Transactions of the International Conference on Sanitary Engineering, London, 1924, which reached this country just as we were going to press in the form of a 383-p. bound volume. The sole agent for the sale of the Transactions in the United States is the American Public Health Association, which will fill cash orders, postpaid, for $4.50.

THE GOVERNMENT OF METROPOLITAN AREAS, a short pamphlet published by the Detroit Bureau of Governmental Research (Detroit, Mich.) outlines the object and government and gives the area and a few other physical statistics of 14 such areas, including three in Canada and the London districts in England. The data presented separately are summarized and a scheme is outlined for a Detroit Metropolitan District.

A MONOGRAPH on City and Village Planning, by George H. Herrold, chairman City Planning Committee, the League of Minnesota Municipalities, and city planning engineer of St. Paul, has been published by the League as a thin pamphlet. (Address, University of Minnesota Library, Minneapolis.)

A RÉSUMÉ of Farm Drainage Methods, Survey and Design, 1908-1922, composes Bulletin 216 of the University of Minnesota Agricultural Experiment Station (University Farm, St. Paul). In its 70 pp. H. B. Roe, Division of Agricultural Engineering, takes up the subject indicated in some detail. The pamphlet contains a number of tables and illustrations.

FROM THE MAINE TECHNOLOGY EXPERIMENT STATION (Orono, Me.) comes a short bulletin on a Correlation Study of the 7-Day Compression Test Upon Maine Sands, by John W. Gowen and Walter H. Leavitt.

CONDITION PER CENT TABLES to the second decimal place "for all combinations of age and probable service lives from 1 to 100 years for compound interest rates of 0, 2, 3" to 8 per cent have been compiled and published by the Engineering Experiment Station (Ames, Iowa; apparently free on request).

SMOKE-ABATEMENT STUDIES at Grafton, W. Va., with especial attention given to locomotive smoke, makes up Technical Paper 338, U. S. Bureau of Mines (one copy free from Bureau of Mines, Washington, D. C.; extra copies 15c. from Superintendent of Documents, Washington, D. C.) The authors are Osborn Mounett and L. Russell Hughes.

COMMENTS on the Use of United States Government Specification Paints and Paint Materials, by P. H. Walker and E. F. Hickson, chemist and associate chemist, U. S. Bureau of Standards comprise a 20-p. pamphlet which may be had only by sending the Superintendent of Documents, Washington, D. C., 10c. for this number or $1.25 for a yearly subscription to the Technological Papers of the Bureau of Standards.

RAINFALL AT VARIOUS STATIONS on the River Po, Italy, 1913-22, are summarized in a large-paged pamphlet of about 115 pp., received from Ministero dei Lavori, Pubblici, Servizio Idografico, Parma, Italy.

CENTRAL AND DISTRICT HEATING, The Possibilities of Application in Canada, by F. A. Combe, has been put out by the Dominion Fuel Board in co-operation with the Mines Branch, of the Department of Mines, Canada (Ottawa, Ont.). It reviews the fuel situation in Canada (with a map showing the location of the principal sources of fuel in Canada and the northern part of the United States) and the relation of district heating to the generation of electric power and the disposal of city refuse. The principal district heating undertakings in the United States and Canada and a few typical central heating plants are outlined.

A MODEL SPECIFICATION for Water Pipes and Fittings is included in a brief report by a committee appointed by the British Ministry of Health to advise him on "(a) the construction and standardization and testing of water pipes and fittings" and on "(b) bylaws for preventing the waste, undue consumption, misuse, or contamination of water." The committee has 23 members of whom six are engineers for various water undertakings and the others represent the Ministry of Health, manufacturers of pipe and fittings, associations of plumbers, a property owners association, etc. M. B. Percy, of the Ministry of Health, Whitehall, Westminster, is secretary to the committee. The specifications mentioned deal with supply (house service?) pipes, distributing, flushing and warning (overflow telltale) pipe, cisterns (tanks), water closet and various other plumbing fixtures forming a part of the water-supply system within houses. Particular attention is given to "taps" (faucets) and valves. The second portion of the "reference," standardization and testing bylaws, etc., will be dealt with in a later report. (Threepence, from H. M. Stationery Office, Adastial House, Kingsway, London, W. C. 2, England or any bookseller in England.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

HYDRAULICS: WITH WORKING TABLES—By E. S. Bellasis, M. Inst. C. E., Recently Superintending Engineer in the Irrigation Branch of the Public Works Department of India; Author of "River and Canal Engineering," "Irrigation Works," etc. Fourth Edition. New York: Spon & Chamberlain; London, E. & F. N. Spon, Ltd. Cloth; 6x9 in.; pp. 348; 160 drawings. American price "about $6."

The extensive revision given to this book in its third edition is now followed by the addition of material regarding work done in Egypt and elsewhere on "flow through sluices, with the laws governing silt and scour, and with new methods of discharge observation." The present edition has the same number of pages as did the third. The first edition was reviewed by the late George W. Rafter in *Engineering News*, Aug. 20, 1903, and the third edition by Robert E. Horton in *Engineering News-Record*, Jan. 20, 1921.

MECHANICAL WORLD YEAR BOOK: 1925. Manchester, England; Emmott & Co., Ltd. Cloth; 4x6 in.; pp. 348, including tables; illustrated. 1/10 postpaid, Manchester.

THE LIFE OF PASTEUR—By René Vallery-Radot. Translated from the French by Mrs. R. L. Devonshire. With an Introduction by Sir William Osler, Bart, M.D., F.R.S., Regius Professor of Medicine, Oxford University. Garden City, N. Y.: Doubleday, Page & Co. Cloth; 6x9 in.; pp. 484; frontispiece portrait; index. $3.

SIXTY-THREE YEARS OF ENGINEERING, Scientific and Social Work—By Sir Francis Fox, M. Inst. C. E., Hon. Assoc. Royal Institute of British Architects. London: John Murray. Cloth; 6x9 in.; pp. 338; 20 halftones, 28 line cuts. 18s. net.

CHARLES PROTEUS STEINMETZ: A Biography — By John Winthrop Hammond. New York: The Century Co. Cloth; 6x9 in.; pp. 489; 18 halftones. $4.

STEAM POWER PLANT ENGINEERING—By George F. Gebhardt, M.E., A.M. Professor of Mechanical Engineering, Armour Institute of Technology, Chicago, Ill. Sixth Edition rewritten. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth, 6x9 in.; pp. 1036; illustrated. $6.

Advantage has been taken of the opportunity afforded by the revision "to make changes in matter and in arrangement to make the volume more useful as a textbook." The fifth edition was reviewed in our issue of Jan. 17, 1918, p. 129. Previous editions were reviewed Nov. 13, 1913, p. 1000 and Nov. 12, 1908, p. 534. The author deserves commendation for covering his field in less space in this than in the earlier edition.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Experience With Vitrified Clay Water Mains Under Pressure

Sir—Recently a small water-supply system was designed about a half mile in length having the outlet about 10 ft. lower than the intake but with two places in the line which had a head of between 15 and 16 ft.

Vitrified clay pipe, 8 in. in diameter was used, with joints of jute and cement, as in sewer construction. Upon turning in the water from the spring, which flows at the rate of 100 gal. per minute, it was found that the pressure at the first head or low place was such that all the water was lost by leakage at the joints through the cement packing. Subsequently these joints were incased in 4 in. of concrete and water was obtained but with a very considerable decrease in the volume, showing that other joints under slighter pressure were leaking.

I would appreciate being advised of any experience where vitrified clay pipe has been used with any head, or any opinions.

P. T. HYLAND,
Toronto, Ont., Feb. 5. Civil Engineer and Contractor.

In Defence of the Narrows Tunnel Contract

Sir:—The editorial in *Engineering News-Record*, Feb. 12, 1925, p. 261, with reference to the form of contract for the Narrows Tunnel recently adopted by the Board of Estimate and Apportionment demands a vigorous protest.

Your implication that this contract was conceived in an atmosphere of subterfuge and artifice is as erroneous as your gratuitous assumption that the conditions which determine its form are deplorable in the sight of the engineer. The project to which this contract relates is unusual in many respects. The proposed tunnel, as you are aware, will be the longest subaqueous tunnel to be undertaken up to this time and the cost of construction will involve an amount that would probably make a separate contract for the entire work the largest municipal contract ever awarded. It has been found practicable to construct the tunnel by either of two distinctive methods, which together with the provision for receiving alternative bids, will increase the competition and insure the most advantageous terms to the city.

The debt limit restrictions as fixed by the existing statutes is of course a condition that would be encountered in any program of improvement wherein the units involved large sums of money and extended over a long period of years. The studies and investigations made in developing the form of contract to meet these conditions brought out the fact that the particular requirements of the project could be carried out in a practical manner under this contract with fairness to all interests concerned. The fundamental principles upon which the contract is based are very similar to those which have been tested by many years' successful use in the United States government contracts, with sufficient variation in the details to meet the specific requirements of the state statutes. A thorough knowledge of the contemplated improvement and study of the contract provisions will demonstrate the fact that this form of contract provides a practicable and reasonable means of carrying out the work in a manner that is equitable both to the city and to the contractor. None of the advantages of the proposed form of contract was brought out in the editorial comment, and it seems unfortunate that an attempt was made to reach conclusions on its merits before the contract and its provisions had been examined in detail.

Your editorial also accepts the edict of Commissioner McAvoy with respect to the proposed use of this tunnel for freight and rapid transit purposes under the apparent assumption that his conclusions were the result of a careful investigation. As a matter of fact, no investigation whatever was made into this question, which furthermore was wholly outside the scope of the inquiry which he conducted into the affairs of the Transit Commission. My protest against the findings as entirely unwarranted has been given publicity elsewhere.

ARTHUR S. TUTTLE,
New York City, Chief Engineer, Board of Estimate
Feb. 16, 1925. and Apportionment.

Transmission Towers of High-Strength Steel

Sir—*Engineering News-Record* of Dec. 25, 1924, p. 1026, described a new steel of increased strength used in Germany, having an ultimate strength of 78,500 lb. per sq.in., a yield-point of 44,000 and an elongation of 20 per cent. The material is straight carbon steel. Its ductility is said to be slightly less than that of ordinary soft steel, and it is used with working stresses 30 per cent higher than ordinary steel.

For the last five years the Pacific Coast Steel Co. has been making a special high-elastic-limit steel at its plant in San Francisco, similar in many characteristics to the steel described in the above-mentioned article. It is a low-carbon steel, soft and ductile, with the following guaranteed properties: Yield point, 45,000 lb. per sq.in.; minimum elongation, 20 per cent in 8 in.; reduction of area, 50 per cent. It will bend flat upon itself in a piece of any thickness without sign of fracture. Many samples of this steel have been tested and many have shown yield points up to 52,000 or 53,000 or even higher, with elongation from 22 to 30 per cent. The flat bend test is considered very important as it shows the softness and toughness of the steel. Many samples after being bent flat have been hammered out to thin edges on the bends without developing cracks.

This particular steel has found its most important use in the manufacture of transmission towers, for the fabrication of which the company has a plant in connection with its rolling mills. The value of the steel for this purpose has been recognized by the various power companies of California and the Pacific Coast for some years, and towers and other structures have been designed on the basis of its high elastic limit and other properties.

In the design of a transmission tower this steel is used with working stresses up to 30,000 lb. per sq.in. for tension members; for compression members this value is reduced by column formula. This will give the same safety factor on the ultimate strength of the structure as the use of a working stress of 20,000 lb. per sq.in. with ordinary mild steel of ultimate strength 55,000 to 65,000 lb. per sq.in. and elastic limit one-half the ultimate.

It is, of course, well known that a long slender column, such as are all the important members of transmission towers, will fail when the elastic limit of the steel has been exceeded. In other words, the ultimate strength of a steel tower is dependent upon the elastic limit of the steel of which its members are composed, rather than the ultimate strength of the steel. The Pacific Coast Steel Co. has made numerous tests of full sized towers at its plant and these tests have all emphasized the truth of the above remarks.

Towers designed with these working stresses in the steel have, when tested to destruction, shown ultimate strengths one and one-half time the requirements of the working loads. This means that a tower of this high-elastic-limit steel may be designed on a basis of 30,000 lb. per sq.in. working stress in the steel and actually show under test a safety factor of 1½. If the same tower were built of ordinary steel it would under the same working loads be close to the failure point and would have no factor of safety.

The long high-voltage transmission lines built in the West in recent years are of high-elastic-limit steel and designed and tested on the basis of its use. The 220-kv. Pit River line of the Pacific Gas & Electric Co., and the 220-kv. Eagle Bell line of the Southern California Edison Co., also the 165-kv. Caribou line of the Great Western Power Co. are of high-elastic-limit steel. The Los Angeles Gas & Electric Corp., the Portland Electric Power Co., and the San Joaquin Light & Power Corp., have all built important transmission lines in which the economy and reliability of high-elastic-limit steel in tower manufacture played an important part.

H. G. SHARP,
San Francisco, Calif., Pacific Coast Steel Co.
Jan. 30, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Mining Engineer Nominated as Governor of Alaska

George A. Parks has been nominated to be governor of Alaska, his nomination being sent Feb. 14 to the Senate for confirmation by President Coolidge to succeed Scott C. Bone, who is not an applicant for reappointment and whose term expires on June 15, 1925. The new appointee has been a resident of Alaska for 16 years and is considered officially as the best-informed man on Alaskan conditions ever named for that office. He has been in the Alaskan field service of the General Land Office of the Interior Department since 1907, his duties taking him to every part of it in both winter and summer. He began as a government practical miner in Alaska at a salary of $1,320 and has worked his way up to the position of assistant supervisor of surveys and public lands.

Mr. Parks graduated from the Colorado School of Mines in 1906 and went to Alaska as a mining engineer for several private mining companies, later being appointed practical miner of the General Land Office in 1909. He then became mineral examiner for the Interior Department, his duties consisting of the examination of homestead and mineral claims. In 1918 he resigned from the government service to enter the engineering corps of the Army during the World War. He was commissioned a first lieutenant and promoted to the rank of captain.

At the end of the war in 1919 he reentered the Alaskan service of the Interior Department being advanced to the position of chief of the field division of Alaska, having charge of public lands in the territory. He was made superintendent of townsite sales for the Alaska R.R. and had supervision of the disposition of all the townsites along the railroad. He also acted as trustee in the sale of many other government townsites in Alaska.

In 1924 he was advanced to the post of assistant supervisor of surveys and public lands in Alaska, which placed under his control the entire administration of public lands in the territory, including their survey and disposition under the various homesteading and mineral acts of Congress.

Mr. Parks will not assume office until the expiration of Governor Bone's term on June 15.

Participation in Pan-American Highway Congress Planned

An appropriation of $15,000 to cover the expenses of the United States participation in the Pan-American Highway Congress to be held this year in Buenos Aires is proposed in a resolution introduced into the House of Representatives.

Engineering Fifty Years Ago

From *Engineering News*, February, 1875

AN EMPLOYEE of a law court, however familiar he may be with the ordinary details of legal business, is not usually considered qualified to practice as an attorney; and a hospital nurse may be the attendant of a physician or surgeon in his daily rounds, throughout a lifetime, and yet not be considered a fit person to write a prescription or set a broken finger. People with grievances to relate or bodies to be healed, go to neither one nor the other for advice or medicine, and should either assume to practice in these professions on the strength of his "practical" knowledge, he would at once be dubbed a "shyster" or a "quack," whose patrons must come from the ignorant and disreputable classes of community.

But in the mechanical arts—notably that of construction—the practical man has from time immemorial held high court. From the days of Plato and Archimedes until quite recently, it has been the practice of *savants* to look with considerable disdain upon the application of pure science to purposes of public utility and although many of the great philosophers of bygone days *did* give the state the benefit of their superior knowledge, yet this condescension on their part was generally looked upon as a lowering of the dignity of science.

On the other hand, it was the fashion to describe scientific men as visionary; engrossed in the contemplation of finely spun theories, very beautiful in themselves, but unsafe for use; absent-minded; and in general, totally unreliable and unfit for the practical affairs of every-day life.

But a brighter day has dawned, and in the general diffusion of knowledge that distinguishes the present century, and more especially the last quarter thereof, the relations between the men of science and the men of practice have been recognized, and the mutual dependence on each other acknowledged.

Contracts Let for Port Angeles Gravity Water Supply

Contracts for the new gravity water supply of the town of Port Angeles, Wash., including 7 miles of wood pipe, concrete dam and cast-iron pipe distributing system, have been let to Morse & Wiley of Seattle, Wash. The total amount is $278,093, based on continuous wood stave pipe for the main supply line. Construction work will begin immediately.

Program for Concrete Institute Convention Announced

The American Concrete Institute has just made detailed announcement of the program of its annual convention to be held at the Drake Hotel, Chicago, Feb. 24-27. The meeting starts Feb. 24 with an afternoon session and two coordinate sessions in the evening, one on concrete products manufacture, at which demonstrations of the practical methods of determining economical aggregate proportions in the manufacture of building units, will be given, and one on reinforced-concrete building construction at which some of the practical problems in connection with column and floor forms and shores will be discussed in papers and a five-minute discussion of a number of detailed construction problems to conclude the session. On Feb. 25 there are three sessions—morning, afternoon and evening—and on Feb. 26 two—in the morning and afternoon, the evening to be devoted to the annual dinner. A morning session on Feb. 27 concludes the program.

In addition to the regular committee reports there will be a number of papers, among which are the following: "Theory Must Aid Practice in Concrete Making," by C. P. Richardson, of the Rock Island Ry.; practical experience with designing concrete mixtures, by T. P. Watson, of the Pennsylvania R.R., and A. W. Munsell, of the Delaware River Bridge Joint Commission; notes on laitance, by R. M. Miller, formerly of the Virginian Terminal Ry.; "Concrete from the Viewpoint of Mr. Cement," by Thaddeus Merriman, of the New York Board of Water Supply; "Crazing," by P. H. Bates, United States Bureau of Standards; "Shall Anything be Added to Portland Cement?" by Maximilian Toch, Toch Bros.; "Proportioning Concrete Materials with Special Reference to Highway Construction," by G. W. Hutchinson, formerly of the North Carolina State Highway Department; "Educating the Men on the Job to Quality Concrete," by Prof. W. K. Hatt, Purdue University; "Central Mixing Plants," by W. E. Hart, of the Portland Cement Association; "Design of Reinforced-Concrete Circular Bins for the Storage of Cement," by H. A. Ward, of the Turner Construction Co.

Funds for Topographic Mapping

Some confusion has resulted from the wording of the news item concerning the Temple Bill which appeared on p. 248 of our issue of Feb. 5, 1925. The bill, as passed by the House of Representatives, merely authorizes the expenditure of $950,000 for topographic mapping. No funds for the purpose have yet been appropriated.

Detroit Council Given Plan for Super-Highways

City Plan and Rapid Transit Bodies Submit Proposal for Widening and Opening Streets

Special Correspondence

A plan for a uniform system for street widening and opening for the city of Detroit, outlining the super-highways proposed for the city has been presented to the City Council by the City Plan Commission and the Rapid Transit Commission. Engineers for both commissions recommend that the plan be followed by the legislative bodies and administrative officials in the future to assure the meeting of the needs of a growing city and to avoid in the newer parts, the congested traffic conditions now existing in downtown sections of the city.

The master plan includes all plans of the City Plan Commission and Rapid Transit Commission for super-highways and intermediate traffic arteries inside and without the present city limits. It is designed to meet the requirements of traffic for the next fifty years. A map showing these plans is to be used as a constant guide to officials in ordering street openings or widenings.

Willard Pope, president of the Rapid Transit Commission, has stated that the routes indicated are the result of intensive study by the two commissions in collaboration with the road commissioners of Wayne, Oakland and Macomb Counties, and in addition all the routes have been discussed with authorities of municipalities included within the fifteen-mile circle.

The plan links up the 217 miles of super-highways previously announced with 24 major thoroughfares in the city, each 120 ft. wide. A number of east and west as well as north and south thoroughfares are designated. These 120-ft. major thoroughfares will, according to the plan, tie up with the 204 super-highways and the 120-ft. intermediate mile roads laid out beyond the built-up sections and extending to the 15-mile circle.

It is planned ultimately to have approximately every square mile of the city bounded by a 120-ft. major thoroughfare. The 120-ft. width is recommended by the Rapid Transit Commission because it gives the maximum pavement space for automobiles and other vehicular traffic and will also permit, if the necessity arises, a four-track subway underneath without disturbing adjacent building foundations. To the present time the widening of only two of the proposed major thoroughfares to 120 ft. has been recommended by the Rapid Transit Commission. They are Woodward Ave. and the Dix-High Waterloo Highway. Only the opening up of streets within the city to articulate the proposed major thoroughfares with the 204-ft. superhighway system is recommended. This opening program is recommended to cover the next eight years.

In addition to the 204-ft. superhighways and the intermediate 120-ft. streets dividing the territory into mile squares, proposed secondary thoroughfares are laid out on the map so as to divide the area into half-mile squares.

If the pending Rapid Transit bills are passed by the legislature in time, the Rapid Transit Commission proposes to lay before the City Council its system of subway routes to be submitted to the voters on the April 6 ballot. This is considered the third great step by the commission in planning for the transportation needs of Greater Detroit.

Kansas City Sets Five Days for Water Contract Bids

The dates for receiving bids for the 15 water-works contracts at Kansas City, outlined in our issue of Feb. 15, p. 247, have been fixed by the Board of Fire and Water Commissioners as March 17, 18, 19 and 20. Details as to the division of the work into fifteen contracts are given in a proposal advertisement elsewhere in this issue. Seventeen centrifugal pumps are required, including two 24-m.g.d. and 35-m.g.d. Fuller & Maitland are engineers for the work.

Condemned Dam in Oregon Fails When Overtopped

An uncompleted dam on Bully Creek in eastern Oregon failed on Feb. 5 when water confined above it overtopped the unsupported corewall. The dam was part of an irrigation scheme on Bully Creek, a tributary of the Malheur River, which was abandoned about 1913 when the company failed. It was in a box canyon of basaltic formation and was 150 ft. long. At the time work was stopped a concrete corewall and part of the rock filling had been completed. The corewall was 125 ft. high above the footing, 7 ft. thick at the base, and 4 ft. at the top. The rock filling had been carried to a height of 85 ft., leaving about 40 ft. of the corewall unsupported. The only openings through the dam appear to have been one at a low level either left there at the time of construction for stream diversion purposes or cut through after the dam was abandoned, and another opening 20 ft. square left in the upper part of the corewall for canal gate. A flood some time previous to the one which occurred a few days ago cracked and shifted portions of the corewall.

It appears that the low level opening through the dam had been either partially or completely blocked with debris and that when the recent flood occurred water backed up behind the corewall, and, according to reports, rose to the level of the opening for the canal gate which subsequently became blocked with ice, causing a further rise in the water until the corewall was overtopped and failed.

The dam was condemned by the state in 1916, but no information is available at the present time as to who was made responsible for restoring the channel to its normal condition.

Standard Contract Form Is Approved by Conference

Final Agreement on Building Contract Reached at Washington—Action By A.I.A. Alone Remains

Washington Correspondence

Final agreement on the standard contract form for the building industry was reached by the Joint Conference on Standard Construction Contracts at a meeting in Washington, Feb. 11 and 12. Changes in the proposed arbitration clause of the engineering contract form were suggested at the meeting, resulting in delay in approval of this form. The building contract form will be submitted to the executive committee of the American Institute of Architects for formal ratification, the only remaining step in its promulgation, and is to be issued as the fourth edition of the A.I.A. contracts, with the approval of the other organizations concerned.

The only change made in the final draft of the building contract form was the elimination of the proposed arbitration clause and the substitution of the clause on this subject which is contained in the existing standard document of the A.I.A., this restoration being determined upon as more acceptable to the large number of persons already familiar with the clause in the A.I.A. form.

It is expected that the A.I.A. will issue the new standard forms in the immediate future. All changes in this form, and the principles involved, have had a thorough test over a period of at least 10 years.

When the engineering standard contract was taken up for consideration by the Joint Conference, representatives of the American Society of Civil Engineers and of the American Waterworks Association proposed a new arbitration clause which had been drafted by attorneys of the American Arbitration Society. This contained a detailed method of procedure as to operation of arbitration which some of the other representatives present considered inadvisable for use in the construction industry at this time. The method suggested is that ordinarily used in settling commercial disputes between buyer and seller. The critics of this proposal declared it did not go sufficiently into the matter of securing approval of the arbitration principle, with which they are principally concerned, and that the procedure outlined was too involved to be attempted at once.

A meeting of the Joint Conference with representatives of the American Arbitration Society will be held at the Engineering Societies Building, New York City, Feb. 25, when it is hoped to reach an aggreement on this clause.

John W. Cowper, of Buffalo, representing the Associated General Contractors of America, presided at the session of the Joint Conference. Other organizations represented were: American Institute of Architects, American Association of State Highway Officials, American Engineering Council, American Railway Engineering Association, American Society of Civil Engineers, American Waterworks Association, and Western Society of Engineers.

Important Power Legislation for Pennsylvania Recommended

Governor Pinchot in transmitting the report of the Giant Power Survey Board to the General Assembly of the state of Pennsylvania recommends that the legislature give careful attention to bills which are to be presented to it to put in effect the recommendations of the Giant Power Board. An important feature of the board's recommendations is mass production of electric power through generating stations of great capacity, in or near the coal fields, which will supply high-voltage transmission lines connecting with all other major transmission lines in the state. This power is to be generated and transmitted by private companies so regulated that they will be able to pay a fair return on their invested capital and will be able to attract new capital.

The governor recommends that the Public Service Commission law of the state be amended so that the fair return of these companies and of existing public service companies will be based on "the staple and easily ascertainable basis of money prudently invested instead of upon the unstable, slow, and enormously costly process of valuation of the company's property as of each time the rate is fixed." He also recommends that legislation be enacted to "rescue the regulation of electric service from the destruction now threatened by its conversion into interstate commerce, which will be beyond the control of the state and has not been regulated by Congress."

Arkansas Engineers Come Out in Favor of Registration

The Arkansas Chapter, American Association of Engineers, has appointed a committee to go before the next general assembly of the state to ask for the passage of a law requiring the registration of professional engineers. The law which they propose is based on the standard registration law approved by the national association and which has been adopted, with certain modifications, by 18 states.

Governor Recommends Abolition of N. Y. State Transit Body

Governor Smith of New York, in transmitting the special report of Justice McAvoy on transit conditions in New York City to the state legislature (which report was noted in our news section of Feb. 12, 1925, p. 294), states that although Justice McAvoy finds that the charges preferred against the State Transit Commission are without foundation, with which findings he agrees, yet he believes that the Transit Commission serves no useful purpose as a government agency and should be abolished.

New Water Supply Completed for Napa, Calif.

The completion of a new municipal water plant that provides a mountain water supply for the city of Napa was celebrated January 24. The new supply is taken from the Milliken Creek watershed and stored behind Milliken Dam. This structure is a simple concrete arch 115 ft. high and 750 ft. long built on a 220-ft. radius with a gravity tangent at each end. The storage capacity is 2,000 acre-ft. A. Kempkey, San Francisco, was the engineer on the project.

Florence Lake Tunnel Blast Kills Four Workers

Two fuses cut too short are believed to have been the cause of an explosion that killed four men and injured another on Feb. 4 in the 13½-mile Florence Lake tunnel which is being driven by the Southern California Edison Co.

The heading was in soft ground in which electric firing was not being used and the killed and injured constituted the powder crew which had gone in to place and fire the blasts after the drilling and mucking crews had left. It is believed that a mistake was made in the length of two of the fuses used which resulted in the explosion of these charges before the men had reached a point of safety.

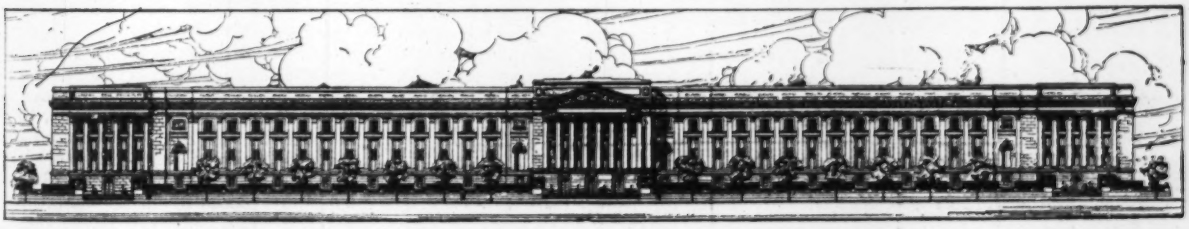
Commission Appointed to Report on Burrard Inlet Bridge

A special commission was appointed recently by the Canadian Government to inquire into the circumstances surrounding a protest by shipping men that the new $2,000,000 road and rail bridge across Burrard Inlet, connecting the city of North Vancouver with the city of Vancouver, was a menace to the passage of shipping. It is claimed that faster currents have been created by the piers. The commission reported that an additional expenditure of $1,500,000 will be necessary to improve the bridge by constructing extra piers and new approaches, but the bridge company, which is composed of representatives of the municipalities affected, declare that it is unable to bear the cost and that the bridge as at present designed is adequate for the needs of the community. The company intimates that construction according to the original plans will be rushed to completion.

Design Competition for Bridge Over Copenhagen Harbor

Prizes are offered by the Municipality of Copenhagen for designs for a bridge over Copenhagen Harbor, according to an announcement just issued by the city authorities. Designs are to be submitted before Sept. 1, 1925. The prizes will total 35,000 kr., of which at least 15,000 kr. will be allotted as first prize. The designs are to be judged by a committee made up of members of the town council and technical advisers selected by the municipality, by the Danish Engineering Association, and by the Association of Academical Architects. The program of requirements, in Danish and English, may be obtained from the city engineer (address: Stadsingenierens Kontor, Raadhuset, Copenhagen, Denmark) on payment of a deposit of 100 kr., returnable when the designs are judged or when the program is returned in undamaged condition. A public exhibition of the designs submitted will be made after the award.

Plans Made for National Museum of Engineering and Industry



The architect's sketch herewith shown is the first reproduction from the completed official drawing of the national museum of engineering and industry to be erected on the Smithsonian Institution grounds on the Mall in Washington, D. C. The building will be a companion building to the natural history museum and the gallery of fine arts. As proposed, the museum will house exhibits depicting the evolution of engineering and the industries and will be the first national institution in this country devoted exclusively to recording industrial progress.

The building as proposed will be 1,150 ft. long, 250 ft. deep, and will cover 27 acres. The central rotunda will house a Hall of Fame for eminent engineers, inventors and industrialists, and a founders' room to commemmorate those who will have contributed to the museum in time, money or effort.

A public building and endowment of $10,000,000 is being raised in the present headquarters of the museum in the Engineering Societies Buildings, 29 West 39th St., New York City.

The president of the museum is Dr. Elihu Thompson.

Report Submitted on Roads of California

Classification, Continuing Income and Concentration on Primary System Recommended

The Committee of Nine appointed last year by Friend W. Richardson, governor of California, for the purpose of getting a group of representative men from different parts of the state to make a thorough survey of the present state highway situation and then submit recommendations calculated to serve as a guide in the formation of needed legislation, has submitted a report signed by eight of the nine members, the member representing the Auto Club of Southern California being not in agreement. The conclusions and recommendations are summarized in the following:

A classification of the present state highways into two general systems designated as primary and secondary systems was recommended. The primary system would include intercity highways, major interstate connections, county seat laterals, other important connections and major recreational highways. The secondary system would include minor interstate connections, minor recreational highways and local development highways.

The committee found it necessary to add certain highways to the state system in order to close obvious gaps in the various routes, thus providing for the more economical and efficient operation of traffic on the primary road system. To this end it was recommended that ten stipulated roads which totaled 196 mf. in length should be made state highways.

Further financing of state highway construction to insure a revenue of approximately $10,000,000 in 1926 and each year thereafter was recommended. Recognizing that the sum of about $200,000,000 will probably be expended in a term of 15 years, four general methods of financing were considered, namely; successive state bond issues, ad valorem tax levied on the general property of the state at rates necessary to produce $10,000,000 per year, direct legislative appropriation at the rate of not less than $20,000,000 per biennium, or finally increased taxes on motor vehicles through either an increased gasoline tax and increased plate tax, or a graduated weight tax to produce added revenue of $10,000,000 in 1926.

After considering these several methods the committee recommended increased taxes on motor vehicles in combination with a $25,000,000 bond issue to be placed before the voters at the next general election and which would be for the purpose of constructing major bridges on the primary road system, and, in co-operation with railroads, for the elimination of railroad grade-crossings on that system.

The committee recommended that at least 75 per cent of construction funds be devoted annually to the construction of the primary system until completed.

Maintenance should be extended by law, it was advised, to all unconstructed state highways open to travel, this for the reason that many years will elapse prior to construction of all state highways and the best possible road service should in the interim be furnished to the public.

Despite the fact that the committee found 57 per cent of the motor vehicle registration to be in the Southern portion of the state while not less than 60 per cent of the future expenditures for state highway construction would be required in the North, the committee nevertheless considered it advisable to concentrate future State highway construction expenditure insofar as possible on the primary trunk system which is of general state importance, and recommended that construction be prosecuted on the primary system at equal rates of annually completed highway mileage in each section of the state.

The committee of nine consisted of A. H. Breed, state senator; George G. Radcliff, chairman state board of control; Arthur E. Loder, manager good roads bureau, California State Automobile Association; Louis Everding, state highway commissioner; R. M. Morton, chief engineer State Highway Commission; Elmer P. Bromley, assemblyman, Los Angeles; J. B. Gill, former county highway commissioner; J. H. Newman, former county supervisor, and E. E. East, engineer, Auto Club of Southern California.

Conowingo Power Work Held Up

Work on the projected water power development on the Susquehanna River near Conowingo, Md., will probably be held up on account of the opposition to the project which has developed in Maryland. There is now considerable doubt as to whether a company such as the Susquehanna Power Co., with a power development extending beyond the state boundaries and proposing to export power to Pennsylvania will be subject to the control of the Maryland Public Service Commission. State officials want definite assurance that the great block of power to be developed at Conowingo can be made available for use within the state when needed. A meeting to discuss this subject will be called in the near future to which the federal, Maryland, and Pennsylvania commissioners, the attorneys general of the two states, and officials of the Susquehanna Power Co. will be invited.

Engineer's Election to Commission Assured at New Orleans

John Klorer, city engineer of New Orleans, received about 56,000 votes for membership on the city commission or council of New Orleans on Feb. 3, and was the only one of 15 candidates for the commission who will not have to run in the second primaries, March 10. The total number of ballots cast was about 73,000. There were three candidates for mayor-commissioner and 12 for the four undesignated department head commissioners. The highest vote for mayor was about 35,500. The votes won by Mr. Klorer's 11 rivals ranged from nearly 30,000 to a little over 1,300. It is considered that Mr. Klorer's election is assured and that he will be made head of the public works department.

Random Lines

Position Open—Don't Crowd

From Technical News Bulletin No. 94, U. S. Bureau of Standards. Feb. 10, 1925:

Standard Hosiery Lengths—The Research Associate of the National Association of Hosiery and Underwear Manufacturers stationed at the Bureau of Standards, has sent to the hosiery research committee a report covering the work on the standardization of methods of measuring the length of all hosiery, and the proposed standards of lengths using this method.

This method of measurement is given as follows:

Ladies' hosiery — Place a ruler so that it touches the lower end of the heel gore and the curve formed at the ankle. The length is the distance from the bottom of the heel to the top of the hosiery as located by this line. (For full-fashioned hosiery this line of length may be determined by laying the ruler so that it touches the curve at the ankle and is parallel to the front line of the hosiery.)

* * *

A Near Member

SAM KERNES

SPECIALIST IN

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NEURALGIA, NERVOUSNESS

HYDRO ELECTRICAL INSTITUTE

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UNDER HOTEL MCKAY DULUTH, MINN.

* * *

Cultural Stuff

Sir—I attended a large meeting of the Virginia Historical Society the other night. In a speech which took one hour and thirty minutes to read, a Yale man referred to the need of the future as being historical engineers and historical architects.

B. T. J.

* * *

Unusual Frankness

An ad in a Denver paper:

Sealed Proposals on the construction of a concrete retaining wall at the Soldiers' and Sailors' Home at Monte Vista, Colorado, to be built by the State of Colorado, will be received until 10 o'clock the ninth day of February, 1925, by the Commissioners for the Soldiers' and Sailors' Home for the purpose of obtaining the estimated cost of such improvement.

No contract for construction will be let on any bids submitted under this proposal.

JUDGE H. M. MINOR, President.
JULIA E. KILLAM, Secretary.
2601 Eudora Street,
Denver, Colo.

No certified check is required, adds M. J. P., who sent the ad in.

New Water Supply and Power Project for Atlanta, Ga.

Studies for a water supply and hydroelectric power project for the city of Atlanta, Ga., were unanimously authorized by city council on Feb. 12. Plans will be made by Paul Norcross, consulting engineer, Atlanta. The general scheme is to construct a dam and large storage reservoir on the Chattahoochee River. Some $900,000 is said to be available to start the project.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 10-12, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Cincinnati, April 22-24, 1925.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Louisville, Ky., April 27 to May 2, 1925.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Convention, Chicago, May 12-14, 1925.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

The Iowa Engineering Society at its recent convention at Des Moines, Ia., elected Prof. J. J. Hinman, associate professor of sanitation at the University of Iowa, president; P. R. Hopkins, vice-president, and John S. Dodds, secretary-treasurer. The society adopted a resolution establishing an award in memory of John H. Dunlap, former professor of sanitary engineering at the University of Iowa, and secretary of the American Society of Civil Engineers at the time of his death. The award is to be given each year to that Iowa engineer judged to have accomplished the most meritorious work of the year.

The Sixth Annual Road Institute under the auspices of the School of Engineering of the University of South Carolina and the South Carolina State Highway Department, was held at Columbia, S. C., Feb. 17 and 18.

The Engineers Club of Cincinnati, at a recent meeting elected O. F. Shepard president and John E. Doran vice-president. Mr. Shepard is president of the Shepard Elevator Co. and Mr. Doran is electrical engineer for the Union Gas & Electric Co. E. A. Gast is secretary.

Personal Notes

The W. K. PALMER Co., engineers, of Kansas City, Mo., have announced the inauguration of a department featuring quantity survey service for contractors, architects, engineers and builders. The service will include legal services for the review of contracts and specifications for contractors.

WALTER H. FLOOD & Co., of Chicago, chemical engineers specializing in the inspection of paving construction, have opened an office at Nashville, Tenn.

O. E. STREHLOW, formerly engineer for James O. Heyworth, engineer and contractor, has been elected president of Walsh & Masterson, Inc., Chicago, a firm specializing in pile driving. During the past 27 years it has constructed pile foundations for 243 structures.

GEORGE H. SHAW, for five and one-half years chief of the Division of Housing and Sanitation in charge of the regulation of housing, sanitation and plumbing in Philadelphia, has resigned and will become district engineer of the Eastern Clay Products Association with headquarters in Philadelphia.

EGBERT S. NEEDHAM, bridge engineer for Armstrong Whitworth & Co., Ltd., of London, England, has been appointed to represent this firm in Colombia, South America, for the construction of the Magdalena River bridge at Girardot, with headquarters in Bogota.

J. S. WATKINS, who has been acting engineer of construction for the State Department of Public Roads of Kentucky, has been appointed to the position of first assistant state highway engineer; this position has just been re-created after having been abolished some time ago. The department will now have, also, an engineer of construction and an engineer of maintenance. The appointments to these positions are H. D. PALMORE, formerly Second District engineer, appointed engineer of construction, and A. W. PARTEE, formerly First District maintenance supervisor, appointed engineer of maintenance for the state department. The position of right-of-way engineer, now held by L. D. HOLLINGSWORTH, will be discontinued March 1.

WILLIAM GAVIN TAYLOR, who resigned as deputy chief engineer of the Passaic Valley Sewerage Commission and became advisory sanitary engineer to the commission and consulting engineer on trade wastes and sewerage to the City of Paterson, N. J., has been made city engineer and street commissioner of Paterson. A consolidation of the two offices by legislative act into a single office bearing the title of chief engineer, in charge of all engineering construction and maintenance work undertaken by the city, is proposed. Among important problems now confronting Paterson are a redesign of its sewerage system, so as to separate storm and sanitary sewage; provision of larger garbage and refuse incinerator; valuation of the property of the local water company for possible acquisition by the city; grade crossing elimination along the line of the Erie Railroad.

R. F. MACDOWELL, formerly county sanitary engineer, Ohio County, Ohio, was released from that service on Jan. 1 and has opened an office in Cleveland for the practice of civil and sanitary engineering.

MURRAY H. MELLISH, formerly with J. G. White Engineering Corp. and later resident engineer for Weston & Sampson, consulting engineers of Boston, has joined the hydraulic division of Stone & Webster, Inc., in their Boston office.

WILLIAM NOYES has entered the engineering force of the hydraulic division of Stone & Webster, Inc., Boston, Mass. Mr. Noyes was previously engaged in making water power investigations and reports for Howard M. Turner, consulting engineer of Boston.

EDWARD A. RUDULPH, formerly assistant engineer of the hydro-electric department of the West Penn Power Co., is now engineer in the hydraulic division of Stone & Webster, Inc., Boston.

JOHN H. WINTER, formerly with the Alabama Power Co., has become a member of the hydraulic division of the Engineering Department of Stone & Webster, Inc., Boston.

GEORGE B. GASCOIGNE, consulting sanitary engineer, Cleveland, Ohio, announces the extension of his offices to include a sanitary laboratory for the examination of water, sewage and industrial wastes, and the new location of office and laboratory at 1149 Leader-News Building, Cleveland. Mr. Gascoigne since his graduation from Ohio State University in 1910 has been continuously active on sewage disposal problems; he was connected with the design and construction of the large interceptor sewers and of the two main sewage disposal works at Cleveland, and with the sanitary projects of a number of Ohio cities.

E. L. BRUNER, architect, has recently been made a member of the firm of Hamm & Grant, Inc., architects and engineers, engaged in the design and erection of commercial and industrial buildings throughout southern California. Mr. Bruner was formerly structural designer with the California State Harbor Commission, and more recently chief structural designer for the Spreckels Sugar Co. at San Francisco.

B. H. KLYCE, C. N. HARRUB and WILLIAM E. WILBUR announce their association under the name of Klyce and Harrub, to practice engineering, with offices in the First National Bank Building, Nashville, Tenn. The practice of engineering will be carried on as heretofore by Mr. Klyce covering municipal, highway, structural, and drainage improvements; Mr. Harrub will give special attention to sewer systems, sewage disposal, and public water supplies; and Mr. Wilbur will give special attention to structures of reinforced concrete and steel.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

One Size for Sand Lime Brick

Following the example set by the face brick and common brick industries, the Sand Lime Brick Association, at a convention held recently in Toronto, Canada, adopted recommendations to the effect that, beginning Aug. 1, they would concentrate on one "recognized" size of sand lime brick. This size will supplant 45 varieties now made, and will be 8 in. long, 3⅝ in. wide and 2¼ in. thick. The action was taken as a result of co-operation of the Division of Simplified Practice, Department of Commerce, with the industry, the distributors and the consumer interests.

Structural and Ornamental Ironwork Shows Big Increase

The Department of Commerce announces that according to data collected at the biennial census of manufactures, 1923, the establishments engaged primarily in the manufacture of structural and ornamental ironwork, such as girders, columns, trusses, grilles, railings, fire escapes, and other builders' ironwork, reported products valued at $404,924,956, an increase of 61.9 per cent as compared with 1921, the last preceding census year.

In addition, structural and ornamental ironwork was manufactured to some extent as a secondary product by rolling mills and by some establishments engaged primarily in other industries. The value of such ironwork thus produced outside the industry proper in 1921 was $18,863,376, an amount equal to 7.5 per cent of the total value of products reported for the industry as classified. The corresponding value for 1923 has not been ascertained but will be shown in the final report of the present census.

Pennsylvania, the leading state in this industry, reported products valued at $96,267,125, or 23.8 per cent of the total; Illinois was second with $39,315,802, or 9.7 per cent; and New York third with $38,637,151, or 9.5 per cent. The combined output reported by these three states was valued at $174,220,078, or 43 per cent of the industry total.

Of the 1,055 establishments reporting for 1923, 235 were located in New York, 120 in Pennsylvania, 104 in Illinois, 78 in California, 72 in New Jersey, 63 in Massachusetts, 38 in Missouri, 30 in Michigan, and the remaining 315 in 28 other states and the District of Columbia.

The statistics for 1923 and 1921 are summarized in the statement below. The figures for 1923 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

STRUCTURAL AND ORNAMENTAL IRON WORK 1921-1923

	1923	1921	Per Cent of Increase
Number of establishments	1,055	1,021	3.3
Wage earners (average number) *a*	51,537	32,897	56.9
Maximum month	Aug. 54,455	Jan. 38,290	....
Minimum month	Jan. 47,301	Dec. 30,527	....
Per cent of maximum	86.9	79.7	....
Wages	$80,809,280	$47,455,082	70.3
Cost of materials (including fuel and containers)	$225,370,991	$151,010,906	49.2
Products, total value	404,924,956	250,085,446	61.2
Value added by manufacture *b*	179,553,965	99,074,540	81.2
Horsepower	205,607	(c)	....
Coal consumed (tons of 2,000 lb.)	283,055	(c)	....

a Not including salaried officers and employees nor proprietors and firm members. Statistics for these classes will be given in final report.
b Value of products less cost of materials.
c Not reported.

To Review Experience with New Concrete Mixer Standards

A meeting of the Mixer Manufacturers Bureau, affiliated with the Associated General Contractors of America, will be held in Chicago Feb. 20 to discuss the results of the adoption of standards as to size and capacity, of concrete mixers in the light of the experience accumulated during the few months these standards have been in practice.

When the standards for concrete mixers were formulated and adopted by the manufacturers who subsequently formed the Mixer Manufacturers Bureau as an affiliated organization of the Associated General Contractors it was recognized that there might arise the necessity for changes as theory was translated into experience. While there have appeared thus far no major suggestions for changes in the standards, the entire subject will be reviewed in detail at the Chicago meeting, and other subjects will be discussed. Gen. R. C. Marshall, Jr., general manager of the A.G.C., will attend the meeting as the representative of that organization.

Tractor Exposition Organized

To demonstrate the application of equipment and attachments for use in connection with McCormick-Deering tractors—which are made by the International Harvester Co.—there has been organized in Chicago the Industrial Tractor Equipment Exposition. The general manager of the exposition is F. Norwood Wilson, 3131 Shields Ave., Chicago.

Monthly Index Number for Locomotive Crane Sales

January sales of locomotive cranes by the seven member companies of the Locomotive Crane Manufacturers Association represented 40 per cent of the normal producing capacity of the plants reporting. This figure represents a gain of 12 per cent over the sales for December, 1924. For the entire year of 1924 the association members worked on about 50 per cent capacity in locomotive cranes.

INDEX OF LOCOMOTIVE CRANE SALES

Month, 1925	Per Cent of Normal Capacity
January	40

Foregoing figures based on returns received from following manufacturers:

Brown Hoisting Mchy. Co.
Browning Co.
Industrial Works
Link-Belt Co.
McMyler-Interstate Co.
Ohio Loc. Crane Co.
Orton & Steinbrenner

Business Notes

BECKWITH MACHINERY CO., Philadelphia, is now agent for the T. L. Smith Company, Milwaukee, succeeding the J. J. Shannon Co. The Beckwith company also has offices in Pittsburgh and Cleveland and represents the Smith company in those cities as well, maintaining a full warehouse stock of mixers and parts.

HENRY A. HITNER'S SONS CO., Philadelphia, dealer in iron, steel and metals, and used contractors' equipment, announces that the creditors' committee which has been operating its business during the past eighteen months has been dissolved and the stockholders have resumed control of its affairs. At their recent directors meeting officers of the company were elected as follows: President, J. G. Hitner; vice-president, Edward L. Lupton; secretary, H. A. MacMullan; treasurer, W. Perry E. Hitner; assistant secretary and treasurer, F. R. Johnson.

EMANUEL SLAG CO., INC., whose main office is at Allentown, Pa., and whose plants are located at Easton and Catasauqua is planning to construct a third plant in the Lehigh Valley half way between Allentown and Catasauqua. The new plant will have a capacity of 1,000 to 1,200 tons of slag daily which can be shipped either by the Philadelphia & Reading R.R. or the Central R.R. of New Jersey.

GEO. W. WALTERS has been appointed district manager of the Northwestern territory for the Traylor Engineering & Mfg. Co., with headquarters at 815 Alaska Bldg., Seattle, Wash.

W. H. AGENS, formerly district manager of the Traylor Engineering & Mfg. Co.'s Seattle office, has been appointed district manager of the Southwestern territory for the same company, with headquarters at the I. W. Hellman Bldg., Los Angeles, Calif.

GEORGE L. SAWYER, who has been with the Barber-Greene Co., manufacturer of loading and conveying ma-

chinery, of Aurora, Ill., for the last five years and has been its representative in New York, has severed his connection with that company. S. D. Brown succeeds Mr. Sawyer in charge of the New York office at 141 Center St.

WILLIAM H. UTZ, vice-president and formerly European director of Jenkins Bros., Ltd., London, has been made director of sales for Jenkins Bros., manufacturers of valves, New York.

HOLT MANUFACTURING CO., Peoria, Ill., announces the appointment of Zach Johnson, Pasadena, Md., as distributor for its caterpillar tractors for the State of Maryland, except Garrett, Alleghany and Washington counties.

CONCRETE ENGINEERING CO., held its annual sales conference at the Drake Hotel, Chicago, recently. C. L. Meyer of Omaha, president of the organization, presided. The company specializes in steel forms, reinforcing material and weather strips. The conference program included an inspection of various steel mills in the Chicago district.

CENTRAL CLAY PRODUCTS CO., Wilkes-Barre, Pa., announces the appointment of R. T. Hutchins as president. Mr. Hutchins was formerly vice-president and sales manager of the Mack Manufacturing Co., Wheeling, W. Va.

KOPPEL INDUSTRIAL CAR & EQUIPMENT CO. of Koppel, Pa., announces the opening of a new sales office in the Rialto Building, San Francisco, under the management of Harry C. Kraft. This new agency will be known as the Koppel Sales Co., Inc. Both sales and engineering work will be handled by this office. Engineering will be under the management of A. E. Prager, who has had many years' experience in designing and perfecting cars for contracting and engineering purposes, and sales under the direction of Mr. Kraft.

STOCKLAND ROAD MACHINERY CO., Minneapolis, Minn., manufacturer of road graders, scarifiers and scrapers, has appointed Wettlaufer Bros., Ltd., Toronto, manufacturers of concrete and brick machinery, as distributors for Stockland equipment in the Province of Ontario.

VICKERS & COMBUSTION ENGINEERING, LTD. has recently been incorporated to take over the Canadian sales and other interests of Vickers Ltd., London; Combustion Engineering Corporation, Ltd., Toronto; International Combustion Engineering Corporation, New York City and the industrial department of Canadian Vickers, Ltd., Montreal. The new company has sales and engineering offices in Montreal, Winnipeg, Vancouver and Toronto with facilities for supplying hydraulic turbines and accessories, penstocks, governors, Diesel engines and oil burners, steam engines, turbines and boilers, electric boilers, mining and general machinery.

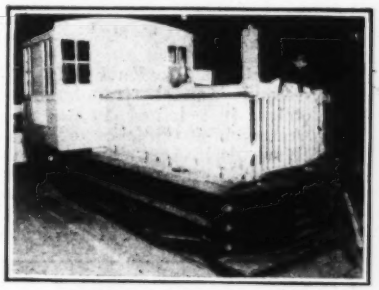
GUIBERT STEEL CO., Pittsburgh, held its annual stockholders and directors meeting Jan. 19. The company had a profitable year and a substantial amount was added to the surplus. The stock was placed on a conservative dividend basis. The board of directors was increased from five to seven by the addition of two employees, Miss M. G. Stewart and Jerome Wolff. The present directors and officers were re-elected.

Equipment and Materials

New 18-Ton Gas Locomotive for Switching and Industrial Service

An addition to its line of gasoline industrial locomotives has recently been made by the Fate-Root-Heath Co., Plymouth, Ohio, in the form of a large and powerful four-speed model weighing 18 tons and intended for use in switching railroad cars and handling big industrial and construction cars. The machine can be furnished in all track gages from 23⅝ to 56½ in.

Strong and rugged design is one of the features of this unit. The frame is



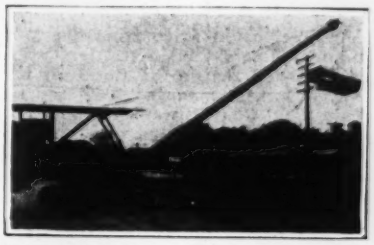
exceedingly heavy, with steel girder-beam and bar sides, and cast steel bumpers of liberal dimensions. All four of the 33-in. wheels are drivers and the axles are of alloy steel, heat-treated and fitted with Hyatt roller bearings in dust-proof journal boxes carrying bronze thrust plates to take care of the thrust of the axles. Easy riding is assured by coil springs on the journal boxing.

The power plant is a 107-hp. Climax six-cylinder gasoline engine with full force feed lubrication and built-in governor. A 12-volt back-geared motor and large storage battery afford a positive starting unit. The clutch is a combination of the Twin Disc and Plymouth designs and the transmission is of the company's sliding gear type with four speeds both forward and reverse, ranging from 2⅜ to 24 miles per hour. Ball-bearing mountings are provided for all shafting and bevel reversing gears. Hand brakes on all four wheels are ordinarily furnished for industrial service, but for them automatic air brakes may be substituted for railroad service. A positive flow of sand on the tracks is secured, when needed, by air operation.

For the 56½-in. gage locomotive the overall dimensions are: Height, 11 ft; width, 10 ft; length, 21 ft. 4½ in. Two seats are provided for the operator, one for travel forward and the other for reverse. Trials of this model in actual standard-gage railroad switching service, the manufacturer states, have demonstrated smooth haulage, easy control and ample power.

Light Weight Crane on Crawler or Truck Mounting

Designed for mounting either on crawler treads or a motor-truck chassis, a gasoline locomotive crane has been developed by the Speeder Machinery Corporation, Fairfield, Iowa, for clamshell, dragline or shovel service. With a crawler mounting, the machine



weighs 1,800 lb., resulting in a bearing surface on the ground of 5.5 lb. per sq.in.

For clamshell service the equipment consists of a 26-ft. boom and ½-yd. bucket, while for shovel service there may be substituted a 16-ft. boom, 12-ft. dipper stick, and ½-yd. dipper. The crane is powered by a 4 x 5-in. Hercules gasoline engine and a new feature of the mechanism is the provision for two speeds on the drums as well as the traction. There are in all three main drums and a boom hoist drum, making unnecessary additional attachments for conversion to dragline or shovel service. The drums may be controlled independently or the holding drum may be controlled automatically in connection with the hoist drum for clamshell work. Only two sets of bevel miter gears are used on the machine. The manufacturer points out that the crane is constructed so that it can be shipped intact, loading and unloading under its own power.

Several New Details Added to Revolving Shovel

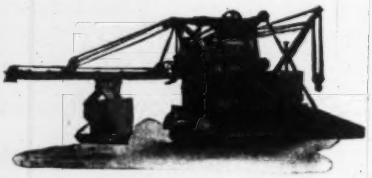
On its small revolving power shovels, ranging in dipper capacity from ¾ to 1¼ cu.yd., the Marion Steam Shovel Co., Marion, Ohio, has recently incorporated several new details to improve their service as road-building and general utility machines. By the addition of a base board to the front of the cab, at the base of the boom, the front end doors are made shorter and can be easily opened or closed. An automatic

trip rope take-up is a standard feature on the small revolving steam machines. This keeps the slack out of the trip rope at any position of the dipper. An operator's seat, adjustable in any direction to suit the operator, is also standard on these small models.

Improvements Speed Discharge of Paving Mixer

A direct chain drive from the gasoline engine to the main countershaft is an improved feature of the 1925 Rex paving mixer manufactured by the Chain Belt Co., Milwaukee. The new drive is a double strand of high-speed chain of special alloy steel completely enclosed in a semi-steel cast housing and running in a bath of oil.

The machine is also equipped with the latest improved folding top frame



which can be quickly folded for passage of paver under low bridges, electric wires, viaducts, etc.

The outstanding feature from an operating standpoint, the manufactures points out, is rapidity in discharging. The paver will discharge a full batch of concrete, regardless of the consistency, in 8 sec. It is able to accomplish this due to the fact that the discharge chute is pivoted on the outside of the drum which enables the use of an oval shaped chute which conforms to the circumference of the drum opening. This shape of the chute allows it to be placed lower in the drum which permits the use of oversized discharge buckets or shovels. The pivoting of the discharge chute outside of the drum also eliminates any chute arms or working parts inside of the drum at the discharge opening, the use of which would necessarily restrict the drum opening, the size of the discharge chute and decrease the speed of discharge.

Publications from the Construction Industry

Rock Drills — GILMAN MANUFACTURING CO., East Boston, Mass., has issued three illustrated bulletins dealing respectively with its hand held rock drills, mounted drills, and heat treating machines for drill bits. The hand drills are light machines designed primarily for plug-hole drilling in quarries, cutting hitches in tunnel work, and drilling anchor-bolt holes in rock, concrete or other masonry. This machine is intended for holes 1 in. in diameter and 6 in. deep. Heavier types are made for drilling dry holes 8 ft. deep. There is also a hand sinker drill for shaft sinking, which uses a hollow bit and water pressure. It is made in capacities up to 14-ft. hole. The company's mounted drills are all of the hammer type ranging from a small size, known as the bantam for 2-in. holes 12 ft. deep up to a heavy drifter for 2½-in. holes 20 ft. deep. The heavy drifters utilize hollow drill steel through which water under pressure and air pass to remove the rock cuttings. The company's heat-treating machines perform automatically the entire operation of heat-treating a drill bit, insuring uniformity and long service.

Wheelbarrows — STERLING WHEELBARROW CO., Milwaukee, describes and illustrates its line of wheelbarrows, concrete carts and hardware for equipping material-handling trucks, including ball-bearing casters and wheels, axle brackets, etc. The company emphasizes the fact that while its line of barrows includes a large variety of styles and sizes, standardization has been carried to a point which makes necessary very few different parts. There is but one size of wheel for all barrows, any tray will fit all frames, one style of leg only is produced for all wood handled barrows, and one other style of leg for steel handled barrows.

Motor Vehicle Handbook — In the twenty-second annual Handbook of Automobiles, just issued by the National Automobile Chamber of Commerce, New York, 193 motor vehicles are illustrated and 795 models are listed. The specifications, which are grouped in sections, cover 116 passenger cars, 62 commercial cars and motor trucks, 6 taxicabs, and 9 motor buses, which will be produced this year by manufacturers who are members of the chamber. With the exception of five electric vehicles, all are gasoline propelled.

Road Oiler—Good Roads Machinery Co., Inc., Kennett Square, Pa., presents details of its Champion road oiler and accessory equipment in a newly published 23-p. illustrated pamphlet. The distributor, designed for mounting on motor truck, consists of a heavy steel frame supporting an incased tank, a centrifugal pump, a battery of kerosene oil burners, a fuel oil tank, air pump, valves, and distributing manifolds. Tanks are furnished in sizes of 600, 800 and 1,000 gal. capacity. The pump forces the bituminous materials under pressure through pipe lines to the distributing nozzles, the width of the manifold being 8 ft. The pamphlet also illustrates and describes briefly accessory equipment in the form of heating kettles and pouring pots.

Concrete Base for Bituminous Pavement—VIBROLITHIC CORPORATION, Des Moines, Iowa, has recently issued an illustrated pamphlet describing and illustrating the application of the vibrolithic method of construction to bases for bituminous wearing surfaces. Grooves formed in the base by the process of mechanical tamping are claimed to be an advantage in anchoring and bonding the superimposed bituminous mixture, eliminating creeping and waving under traffic.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Large Projects in Prospect

The following represent just a few of the big engineering construction jobs on which bids are asked or will soon be called. Further details are given in the Construction News section of this issue, pp. 87 to 102.

Proposed Work

Transmission lines, Toronto, Ont., Hydro Electric Power Comn. of Ontario, $12,000,000.

Hotel, San Francisco, Calif., Canterbury Hotel Co., $3,000,000 to $5,000,000.

Hotel, Apex, N. C., Pinecrest Hotel Corp. Inc., $3,000,000.

Apartment, New York, N. Y., Primo Building Corp., $2,500,000.

Hotel, New York, N. Y., Four Hundred Sixty Four Corp., $2,000,000.

Office, Houston, Tex., R. S. Sterling, $2,000,000.

Bids Wanted On Big Jobs

Hotel, Houston, Tex., J. Finger, archt., $1,500,000.

High School, Duluth, Minn., C. A. Bronson, secy, $1,000,000.

Large Contracts Let During Week

Mail Order building, Kansas City, Mo., Sears-Roebuck & Co., general contract to Norton Bros., lumber to Badge Lumber and Coal Co., steel to Sheffield Steel Co., $4,000,000.

Chemistry Building, New York, N. Y., Columbia University to T. O'Reilly & Son, $2,375,000.

278 Mi. of Federal-Aid Paving to Cost Eleven Millions

Federal-aid project statements, approved early in January, call for 278.663 mi. of county highways reaching an estimated total value of $11,926,899. These projects cover twenty-six counties in eleven states, according to the following tabulation:

State	County	Length Mi.	Total Estimated Cost
California	Santa Barbara		$1,500,000
Georgia	Habersham	7.300	190,000
	Gordon	20.000	650,000
Illinois	Ford & McLean	32.696	917,800
	McHenry & DeKalb	20.247	613,150
Massachusetts	Worcester	13.000	900,000
	Bristol, Plymouth	3.250	250,000
	Norfolk	6.800	500,000
	Middlesex	4.600	105,000
Nebraska	Brown	13.200	55,000
New Jersey	Ocean, Burlington, Atlantic	48.100	2,397,949
New York	Chautauqua	22.000	1,276,000
Ohio	Cuyahoga	2.400	130,000
	Monroe	18.000	425,000
Rhode Island	Kent	1.870	94,000
South Carolina	Bamberg	2.000	8,000
Virginia	Louisa, Fluvanna, Buckingham, Prince Edward, Bockbridge	52.800	1,600,000
		10.400	315,000
		278.663	$11,926,899

Pennsylvania Has Record Road Building Year

During 1924 the roadways built by the Pennsylvania Department of Highways, new construction and resurfacing, totaled 1,208 mi., the largest mileage completed in any one year in the history of the department.

According to William H. Connell, engineering executive, the following types of pavement were constructed or resurfaced: Reinforced concrete, 567 mi.; bituminous pavement on a concrete base, 11 mi.; bituminous macadam resurfacing, 112 mi.; stone road resurfacing, 518 mi.

One million five hundred thousand sq.yd. of patching were done on 2,960 mi. of macadam road. This patching would have resurfaced 90 mi. of highway 18 ft. in width. A total of 900 mi. of earth roads were widened, 1,886 mi. of macadam were given a bituminous surface treatment and 800 mi. of earth roads were oiled. The Department eliminated 20 grade crossings. Four undergrade or overhead crossings were made safer by reconstruction. In addition, work began on the elimination of 19 additional grade crossings.

The materials involved in the Department's activities totaled 3,606,515 tons, as follows: Cement, 1,802,000 bbl.; sand, 787,800 tons; stone, 2,418,000 tons; bituminous materials, 14,538,200 gal.; traffic paint, 30,000 gal.; whitewash, 31,000 gal.; cable, 347 mi.; guard rail posts, 10,500. In transporting 3,462,888 cu.yd. of materials, 2,360 trucks were required which traveled a distance of 6,200,000 mi. during the season.

Reprints of construction statistics and charts covering 1924 are now available free of charge to those who ask for them. There are eight pages of figures and graphs and six pages of pictures of outstanding engineering works in progress last year. This is in convenient form for filing. Ask the editor for one.

The Editor

ENGINEERING NEWS-RECORD
Tenth Ave. at 36th St.,
New York, N. Y.

January Cement Output Heaviest on Record for That Month

With an unprecedented quantity of cement being produced for this time of the year and mill stocks heavier than usual, the fact that demand is slightly below a year ago would indicate little danger of a noticeable price rise in the very near future.

The January, 1925 output exceeded that for the corresponding month in any previous year, according to the Geological Survey. Cement mill stocks are far in excess of those usually on hand at this period and are exceeded only by the amount available at the end of March, 1924. Mill shipments were slightly below a year ago but greater than those for the month of January in all other years.

PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT

	Jan. 1924 Bbl.	Dec. 1924 Bbl.	Jan. 1925 Bbl.
Production	8,788,000	10,435,000	8,916,000
Shipments	5,210,000	5,506,000	5,108,000
Stocks	14,155,000	13,913,000	17,720,000

Public Bond Sales in January Reach New High Record

An aggregate of $124,931,186 state and municipal bonds was sold during the past month. This makes a new high figure for January according to the *Commercial and Financial Chronicle* January 1922 held the previous high with a total of $108,587,199. The past month's figure makes a good showing with $91,534,522 for December, 1924, and with $94,273,946 for January a year ago.

Among the large issues of the past month, six cities with offerings of $5,000,000 or more each, account for $60,785,000 of the total. The largest issue, $19,555,000 was made by Detroit, Mich. Other large issues were: $12,000,000 Philadelphia, Pa.; $11,500,000, Los Angeles, Calif.; $7,530,000, Chicago, Ill.; $5,200,000, Kansas City, Mo.

The rates ranged from 4¼ to 6 per cent. Most of the bonds went at a premium.

REPRESENTATIVE PUBLIC BOND SALES, JANUARY, 1925

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Illinois	Highway	$4,000,000	4	97.5575	4.287	Jan. 1	1932—39	Geo. B. Gibbons & Co., Inc.
Michigan	Roads	157,000	4¼	100.023	4.73	Feb. 1	May 1926—28	Howe, Snow & Bertles
County								
Allen, Ind.	Roads	47,000	5	104.52	4.46	Sept. 1	1925—44	Fletcher American Co.
Allen, O.	Bridge	39,375	6	107.24	4.49	Nov. 1	1926—34	The Detroit Trust Co.
Baker, Ore.	Roads	350,000	5	105.07	4.76	Dec. 15	20 years	Pierce, Fair & Co.
Baltimore, Md.	School and Roads	1,250,000	4½	103.913	4.17	Feb. 1	1927—49	Alex. Brown & Sons
Bear Lake, Ida.	Roads, etc.	200,000	5½	103.75	4.87	Jan. 1	1935—44	Edward L. Barton Co. and others
Blount, Tenn.	Roads	380,000	5	102.51	4.87	Jan. 1	38 years	I. B. Tigrett & Co.
Cambria, Pa.	Road and bridge	500,000	4½	102.24	4.04	Jan. 15	1926—48	The Mellon National Bank
Chenango, N. Y.	Highway	200,000	4½	101.738	4.11	Feb. 1	1941—50	Sherwood & Merrifield, Inc.
Cuyahoga, O.	Water and sewers	281,500	5	104.04	4.40	Feb. 1	1926—36	Hayden, Miller & Co.
Delaware, O.	Roads	102,000	5	101.28	4.73	Dec. 1	1926—34	Ohio National Bank
Duchesne, Utah	Roads	62,000	5			Jan. 1	1936—43	Palmer Bond & Mortgage Co.
Elkhart, Ind.	Roads	49,000	5	105.58	4.31	June 15	1925—44	The Fletcher Savings & Trust Co.
Essex, N. J.	Vocational Schools	1,095,000	4½	100.48	4.22	Jan. 2	1926—63	The Fidelity Trust Co.
Franklin, O.	Hospital	125,000	4½	103.12	4.17	Jan. 15	1926—37	A. T. Bell & Co.
Huron, O.		25,500	5	101.71	4.585	Sept. 1	1925—33	Prudden & Co.
Harrison, Miss.	Sea wall	2,000,000	5½	101.29		Feb. 1	1926—50	Central State Bank and others
Hendry, Fla.	Highway	430,000	6	100.07	5.99	Jan. 1	1930—54	The Atlantic National Bank
Leavenworth, Kan.	Roads	171,000	4½	100		July 1	1925—39	The Commerce Trust Co.
Luzerne, Pa.	Bridge	500,000	4½	101.41	3.94	Feb. 1	1926—33	Mellon National Bank
Ontario, N. Y.	Highway	210,000	4½	106.222	4.14	Nov. 1	1928—41	Roosevelt & Son
Pike, O.	Bridge	19,950	5	102.09	4.60	Dec. 1	1926—35	A. T. Bell & Co.
Richmond, Ga.	Schools	350,000	4½	102.87	4.84	Jan. 1	1926—55	National City Co. and others
Rockingham, N. C.	Improvement	1,000,000	4½	101.01	4.67	Feb. 1	1926—55	Ames, Emerich & Co. and others
Township								
Ross, O.	Sidewalk	17,000	6	102.77	5.17	Dec. 1	1930—28	Stranhan, Harris & Oatis, Inc.
Rostraver, Pa.	Road	70,000	4½	102.75	4.22	Dec. 1	1930—44	M. M. Freeman & Co.
Municipal								
Akron, O.	Sewer	3,000,000	4½	103.189	4.44	Feb. 1	1926—50	Equitable Trust Co. and others
Bridgeport, Conn.	School	926,000	4½	100.529	4.21	Jan. 2	1926—55	R. L. Day & Co.
Chicago, Ill.	Improvement	7,530,000	4	97.81	4.29	Jan. 1	1926—44	Harris, Forbes & Co. and others
Detroit, Mich.	Improvement	19,555,000	4½	100.42	4.3233	Feb. 1	1927—55	Bankers Trust Co. and others
Flagstaff, Ariz.	Water works	475,000	5½	101.107	5.43	Jan. 1	1936—65	Geo. W. Vallery & Co. and others
Kansas City, Mo.	Water works	5,200,000	4½	103.05	4.24	July 1	1942	Stern Bros. & Co.
Los Angeles, Calif.	Improvement	11,500,000	4½	100.0009	4.67		1925—65	Blair & Co. and others
Minneapolis, Minn.	Improvement	1,340,000		100	4.39		1927—45	Eldredge & Co. and others
Omaha, Neb.	Sewer	500,000	4½	101.71	4.33	Jan. 15	1931—40	W. A. Harriman Co. and others
	Drive	242,000	4½	102.67	4.31	Feb. 1	1945	Esterbrook & Co. and others
Philadelphia, Pa.		12,000,000	4	100.3047	3.985	Jan. 1	1940 and 75	National City Co. and others
Shenandoah, Pa.		200,000	4½	104.84	4.13	Jan. 1	1935—55	M. M. Freeman & Co.
Tampa, Fla.	Waterworks	622,000	5	106.03	4.68	Aug. 1	1949—72	R. M. Grant & Co. and others
Toledo, O.	Improvement	65,000	4½	101.19	4.35	Feb. 1	1927—33	
	Hospital	25,000	5			Dec. 1	1926—30	
Worcester, Mass.	Water	50,000						
	Water	100,000	4	101.09	3.82	Oct.	1925—44	R. L. Day & Co.
	Sewer	225,000						
Windsor, N. C.	Improvement	100,000	6	103.39	5.66	Jan. 1	1928—47	Braun, Bosworth & Co.
Yonkers, N. Y.	School	1,000,000						
	Building	240,000	4½	101.33	4.12	Feb. 1	1927—65	A. M. Lamport & Co.
	Water	400,000						
	Refunding	306,000						

Prices of Roofing Materials Compared

The accompanying tabulation gives a comparison of prices of various roofing materials, used chiefly in residential construction. These quotations are f.o.b. seven important cities, representative of the five great geographic divisions of the United States. Quotations are per 100 sq.ft. for base sizes. The apparently great differences in quotations, observed in comparing one city with another and one material with another, are due to freight charges from point of manufacture in each case, since all of these materials are not manufactured in any given district.

PRICES OF MATERIALS FOR INDUSTRIAL AND RESIDENTIAL ROOFING

Base Sizes—Per 100 Sq.Ft.—F.O.B. Points Named

	Atlanta	Boston	Dallas	New Orleans	New York	St. Louis	San Francisco
Cement tile	$23.00		$18.00@$22.00		$40.00	$8.00@$13.00	
Burned tile	$35.00@$45.00	$10.00@$21.00	30.00@ 40.00		19.32	9.00@ 11.00	$14.00@$22.00
Slate	25.00@ 35.00	11.00@ 21.00	26.00@ 32.00	$16.00@$24.00	14.00	14.00@ 25.00	12.00@ 30.00
Asbestos shingle	32.50	11.00@ 15.00	14.50@ 26.00		9.75	8.50@ 12.25	12.95@ 25.55
Asphalt shingle	11.00	4.75@ 11.00	8.00@ 12.50	6.00@ 7.00	5.80	6.50	9.65@ 13.10

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 5, the next on March 5.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$3.34	$3.90	$4.15	$3.10	$3.35	$3.07½	$3.15	$3.35	$4.25
Structural rivets, 100 lb	4.25	4.45	4.75	3.50	3.75	4.65	5.00	3.80	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.40	3.38	3.00	3.25	3.87½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	54.2%	43%	56½%	54.25%	36%	44.7@55.5%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	54.60@55.60	+58.00	56.00	49.20@50.20	55.50	62.00	53.00	65.00	60.00
Concreting Material:									
Cement without bags, bbl	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	3.00	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.25	1.40	2.00	3.00	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.00	2.83	3.00	1.75	2.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	60.00	34.00	56.00	55.00	39.75	39.75	29.00	23.50	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.50@2.75	1.45	1.85	1.26	1.35	2.70	1.60	2.80	10.50
Common brick, delivered, 1,000	18.00	10.50	+12.10	12.00	—13.50	12.00	15.50	14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	.06	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	.06	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal	1.24	+1.34	1.30	1.25	—1.23	—1.42	1.32	1.12	1.11
Common Labor:									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.75	.50@.55	.35@.50	.50	.50	.20@.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.87). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Conditions Affecting the Market

With the steel industry enjoying greater activity than it has at any time during the past six months, owing principally to heavy demands for structural and railway materials, attention is directed to the slowness prevailing in some of the other basic industries.

Cement demand is lighter than at this time last year, with consequent slackening of movements in concrete aggregates.

Brick output is seasonally restricted, owing to closing of Northern yards in cold weather.

The West Coast fir lumber mills are on five-day week schedules, in this way bringing production nearer to actual demand.

In pine lumber, the past four weeks have brought forth considerable improvement in inquiry and actual purchasing, with upward trend in prices. Cincinnati and Chicago are the chief centers of pine activity, while the St. Louis district reports a fairly good market. Movements are slow in the South and northern New York.

Pig iron prices are advancing in Cincinnati, New York, Birmingham and Chicago. In steel, current demand is running largely to pipe, galvanized sheets, railway materials and bars.

Unfilled orders on books of the U. S. Steel Corporation, Jan. 31, 1925, amounted to 5,037,323 tons, the heaviest since Aug. 31, 1923, at which time the total was 5,414,663 tons.

The price of steel structurals on the date last mentioned was $2.50 per 100 lb. at Pittsburgh mill; present quotations are $2@$2.20 per 100 lb. With every increase in demand the price will approach nearer to the August, 1923 level.

The fact that buying is not only for current needs but also for replenishment of stocks, would indicate little danger of the $2.50 level being reached.